THE FOSSIL TURTLES OF NORTH AMERICA

BY

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PREFACE.

In this treatise on the Fossil Turtles of North America there are described 266 species, of which 76 are regarded as hitherto unknown to science. In the preparation of this work the writer has had access to most of the collections which contain remains of North American fossil turtles. The most important of these collections is that of the American Museum of Natural History, in New York. In this are found many of the specimens described by Professor E. D. Cope, including many of his types. In addition to these, large numbers of turtles have been brought together by the expeditions sent out by this museum during the past fifteen years. Free access has been given the writer to the materials in the United States National Museum, where there are many of the specimens described by Dr. Joseph Leidy and Professor Cope; to those of the Academy of Natural Science of Philadelphia, where are found other materials rendered precious by the labors of the authors just mentioned; to those of the Carnegie Museum, Pittsburgh; the Field Natural History Museum, Chicago; the University of Kansas, Lawrence; the University of Texas, and the University of Nebraska. At Yale University the writer has been permitted to study and describe valuable materials brought together by Professor O. C. Marsh, besides other specimens which form the types of species described more recently by Dr. George R. Wieland. Thru the courtesy of Professor W. S. Valiant some of Dr. Leidy's types preserved at Rutgers College were made accessible. Specimens for study have been sent to the writer from most of the museums mentioned; also from the University of Chicago, by Mr. S. W. Williston; from the University of California, by Dr. J. C. Merriam; from the Geological Survey of Canada, by Mr. L. M. Lambe; and from the Vanderbilt University, Nashville, by Professor L. C. Glenn.

It has been the author's earnest wish to see all the types of the hitherto described species; and most of these have come under his notice. Unfortunately some are without doubt utterly lost; others have, for the time, disappeared from view.

The author has endeavored to illustrate as fully as possible the species described. Whatever may prove to be the little or great value of the text, the writer can commend the illustrations. By far the greater number of the figures of the plates are from photographs which were taken at the American Museum of Natural History by Mr. A. E. Anderson. Other photographs and drawings have been furnished by the Geological Survey of Canada thru Mr. L. M. Lambe; others by Dr. George R. Wieland, of the Yale University Museum; others by Dr. W. J. Holland, director of the Carnegie Museum, Pittsburgh. The photographs of *Basilemys sinuosa* came from the Field Natural History Museum, thru Dr. E. R. Riggs. A considerable number of the drawings found in the plates were prepared many years ago, for the late Dr. George Baur, by the United States Geological Survey; thru the courtesy of the Survey these were placed in the hands of the writer. The majority of the drawings that appear in the text were executed by Mrs. Lindsay Morris Sterling, artist in the department of vertebrate paleontology in the American Museum of Natural History. A number of these text-figures are the work of Mr.

R. Weber, of the same museum. Most of the wash-drawings that appear in the plates were produced by Mr. Erwin C. Christman of the American Museum of Natural History.

The thanks of the author are due, first of all, to the Carnegie Institution of Washington for the support it has given him in the preparation of this monograph; in the next place, to Professor H. F. Osborn, of the American Museum of Natural History, New York, for the opportunity to use the materials in that museum; finally, to all the persons and institutions above mentioned and others who have contributed in any way to whatever there may be of value in this work.

It is not believed to be necessary to append a list of the papers and memoirs consulted in the preparation of this monograph; inasmuch as the writer's Bibliography and Catalogue of the Fossil Vertebrata of North America, Bulletin 179 of the United States Geological Survey, records the literature of the subject up to the year 1901 and the important writings since published are cited in the text of this monograph.

WASHINGTON, *November* 20, 1907.

THE FOSSIL TURTLES OF NORTH AMERICA.

ON THE SOURCES OF OUR KNOWLEDGE OF THE FOSSIL TURTLES OF NORTH AMERICA.

The study of the fossil turtles of North America began in 1851, when Dr. Joseph Leidy described, under the names *Stylemys nebrascensis*, *Testudo lata*, *Emys hemispherica*, and *Emys oweni*, the extremely common fossil turtle of the Oligocene Badlands of the present state of South Dakota, then a part of the Territory of Nebraska. It is true that in 1842 Dr. Richard Harlan had described and figured (Amer. Jour. Sci., XLIII, p. 144, pl. III, figs. 2, 3) as *Chelonia couperi* a bone which he believed to be the femur of a large sea-turtle; but it is quite certain that the bone was no part of any turtle. Dr. Leidy continued at intervals up to 1889 to describe new species of fossil turtles. Most of Dr. Leidy's shorter papers appeared in the Proceedings of the Philadelphia Academy, but his most important illustrated works on the subject are found in D. D. Owen's Geological Survey of Wisconsin, etc., 1852; in the sixth volume of the Smithsonian Contributions to Knowledge, 1854; and in the first volume of the monographs of Hayden's Geological Survey of the Territories, 1872. Professor E. D. Cope began his publications of species of fossil turtles in 1867; his last paper containing matter on the subject was publisht in 1899, after his death. His papers on the subject are numerous and will be found cited in the writer's Bibliography and Catalogue of the Fossil Vertebrata of North America, 1902. Cope's most important expositions of the turtles are to be found in the fourteenth volume of the Transactions of the American Philosophical Society, 1869 and 1870; in the second volume of the Hayden Survey monographs, 1875; in volume four of Wheeler's Survey West of the 100th Meridian, 1877; and in the third volume of the monographs of the Hayden Survey, 1884.

Professor O. C. Marsh described only three species of fossil turtles. No new fossil species are to be credited to Dr. George Baur, but he was the author of a number of papers which made important additions to our knowledge of their structure and relationships. Dr. S. W. Williston and Dr. E. C. Case have contributed a number of valuable papers on the subject, especially on the turtles derived from the Niobrara beds of Kansas. Dr. George R. Wieland has given especial attention to the marine turtles of the Upper Cretaceous; and, especially, he has described that remarkable chelonian monster *Archelon ischyros*.

Other authors who have busied themselves more or less with the North American chelonian population of past times are J. Z. Gilbert, L. M. Lambe of the Canadian Geological Survey, Dr. F. B. Loomis, W. J. Sinclair, E. S. Riggs, and O. P. Hay. The results of the studies of the authors mentioned are that more than 260 species of fossil turtles are now known from the geological deposits of North America; the nearly complete structure of a considerable number of these has been determined and much of that of others; and much light has been gained regarding the history and relationships of the members of the order. Undoubtedly many additional species will be discovered as the years pass away and species now known only from a few bones will become far better known.

ON THE OSTEOLOGY OF THE TURTLES.

The turtles, or tortoises, form an order of the great class of reptiles; and they probably constitute the best defined of all the orders of that class, no member of the group having yet been discovered about whose chelonian affinities there need be any dispute, in case the animal is represented by enough of its skeleton, and nearly every bone of a turtle is so characteristic that its chelonian nature is evident.

It is generally supposed that the most characteristic thing about a turtle is the transformation of the bones of the body walls into a sort of box, into which the animal can withdraw its head, legs, and tail. However, no one would mistake the relationships of the leatherback (*Dermochelys*), altho little more than a crocodile or a cayman does he possess a box into which he can withdraw his exposed members. It is rather the broad, relatively short body of these animals, the small head on a more or less elongated neck, and the toothless, horn-covered jaws that stamp these animals as turtles.

Of turtles existing at the present day there are somewhat more than 200 species. Dr. George A. Boulenger, in his Catalogue of Chelonians (1889), estimated the number at 201 species, and a number of others have been described since that time. They inhabit all the continents and all parts of the continents that are not too cold nor too dry for them. Many islands, even some, as the Galapagos, far removed from continental bodies of land, possess or have possest their species. All the warmer seas are visited by pelagic turtles, of which there are at least 5 species. Even dry and hot deserts may support their peculiar forms of these animals. The geographical distribution of the living species will be discust on another page. The geological history extends back into the middle Triassic; and, with little doubt, turtles existed in the Permian.

THE EMYDIDÆ. THE TERRAPINS.

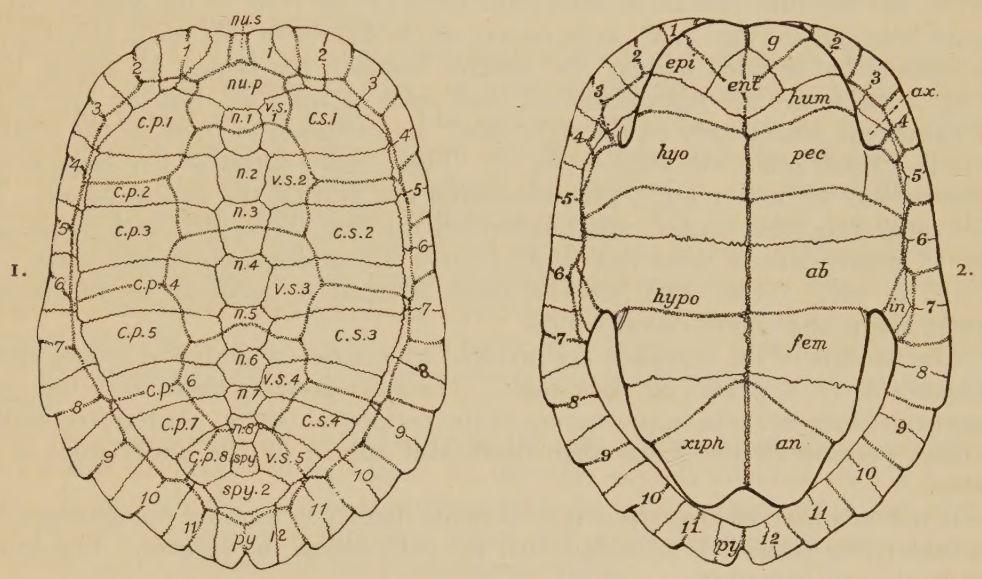
For the information of the reader a general description will here be given of the osteology of members of the principal groups of turtles. We shall begin with the shell of one of the Emydidæ, a central family of the order. This belongs to the geographic turtle (*Graptemys geographica*), an inhabitant of the lakes and larger streams of the Mississippi Valley. The shell reaches a length of at least 225 mm. and is only moderately archt. In this case, as in the great majority of the members of the order, it forms a box into which the head, legs, and tail can be retracted.

The shell consists of two parts, an upper, the *carapace* (fig. 1), and a lower, the *plastron* (fig. 2). On each side, between the fore and the hind leg, the two portions are joined by the *bridge*. The carapace is composed of 50 bones, each of which is articulated by jagged sutures with the adjoining bones. In front and behind the bridges, the outer ring of bones projects freely like the eaves of a roof. Twelve of the bones of the carapace are arranged in a row along the midline. In front is the *nuchal* bone (*nu. p*). Behind this comes a series of 8 *neurals* (*n.* 1, *n.* 2, etc.). The last of these is followed by two *suprapygals* (*spy*, 1, 2), and the hindermost of these is succeeded by the pygal (*py*), forming the last of the median series. The 8 neurals are connected with the neural arches of the dorsal vertebræ, of which they appear to be mere expansions. The nuchal, the suprapygals, and the pygal are not connected with the vertebræ.

On each side of the row of neurals and articulating with them are 8 *costal plates*, or *costals* (*c. p*, 1, 2, etc.). These appear to be only expansions of the ribs; and study of the embryology shows that they are connected with the ribs from the earliest appearance of the bone. Nevertheless, there are reasons for believing that

originally the costals and the neurals were distinct from the ribs and neural spines. Outside of the costals, extending on each side of the body from the nuchal to the pygal, is a series of 11 bones, the *peripherals*, often called the *marginals* (1, 2, etc., on the left side of fig. 1).

Fig. 2 represents the plastron of the same shell. It consists of a median bone, the *entoplastron* (*ent*) and four pairs of bones, the *epiplastra* (*epi*); the *hyoplastra* (*hyo*); the *hypoplastra* (*hypo*); and the *xiphiplastra* (*xiph*). On each side, between the fore and the hind leg, the hyoplastron and the hypoplastron articulate with peripherals 3 to 7 inclusive to form the bridge. The free borders of the epiplastra are modified so as to produce a sort of lip. The rear of the plastron is notcht. The notch from which the front leg protrudes is the *axillary notch*, that from which the hind leg emerges is the *inguinal notch*. That portion of the plastron in front of the axillary notches is the *anterior lobe*, that behind the inguinal notches is the *posterior lobe*.



Figs. 1 and 2. *Graptemys geographica*. ×⅓.

1. Carapace. *c. p.* 1, *c. p.* 2, etc., the costal plates, or bones; *c. s.* 1, *c. s.* 2, etc., the costal scutes; *n.* 1, *n.* 2, etc., the neural bones; *nu. p*, the nuchal plate, or bone; *nu. s*, the nuchal scute; *py*, pygal bone; *spy*, suprapygal bone; *spy.* 2, second suprapygal; *v. s.* 1, *v. s.* 2, etc., the vertebral scutes; 1, 2, 3, ... 12, on the right side, the marginal scutes; 1, 2, 3, ... 12, on the left side, the peripheral bones.
2. Plastron. *ab*, abdominal scute; *an*, anal scute; *ent*, entoplastron; *epi*, epiplastron; *fem*, femoral scute; *g*, gular scute; *hum*, humeral scute; *hyo*, hyoplastral bone; *hypo*, hypoplastral bone; *in*, inguinal scute; *py*, pygal bone; *xiph*, xiphiplastron; 1, 2, 3, ... 12, on the right side, the marginal scutes; 1, 2, 3, ... 11, on the left side, the peripheral bones.

Just behind the axillary notch the hyoplastron sends upward a stout process, the *axillary buttress*, to fit into an excavation in the third peripheral and the inside of the lower end of the first costal. Just in front of the inguinal notch the hypoplastron sends up a similar process, the *inguinal buttress*, which fits into an excavation in the seventh peripheral and the inside of the lower end of the fifth costal. The space on the inside of the shell between the axillary and the inguinal buttresses is called the *sternal chamber*.

Seen from below, each costal plate presents a broad ridge along the middle. This is the true rib; and at the end of the costal this rib enters a pit in one of the peripherals. In this species the peripherals over the bridges are not suturally joined to the costals. At their upper ends the ribs again free themselves from the

costals as *rib-heads*, which articulate with the vertebral centra. At the front of the shell each rib-head articulates with two centra, at their junction with each other; more posteriorly, the rib-head falls farther and farther behind the intervertebral articulation. There is no movement of the rib-heads on the centra, nor of these on one another.

The first dorsal vertebra articulates with the last cervical, permitting a very free motion. Its ribs are short, have no costal plate, and lie closely joined to the front of the rib of the first costal plate. From this it will be seen that the second rib has coalesct with the first costal plate, the third rib with the second costal, and so on. The tenth dorsal rib is short and slender; its distal end is consolidated with the eighth costal plate, and has the upper end of the ilium abutting against it.

In life the bones of the carapace and the plastron are covered by a number of horny plates, the *scutes*. Where the edges of any two of these meet they impress a furrow in the bone, forming a *sulcus*. When the skeleton is prepared the scutes fall off, but the sulci remain to betray the number and form of the scutes. In the figures here shown (figs. 1, 2), as in nearly all the figures of this work, the sulci are represented by stippled bands; the sutures between the bones, by zigzag lines. In fig. 1 the scutes are represented on both sides of the shell, but the symbols of the names are placed only on the right side. Immediately in front, at the midline, there is a small scute, the *nuchal* (*nu. s*). Then comes a row of five large scutes, the *vertebrals* (*v.* 1, *v.* 2, etc.), each extending out beyond the neural bones. The sulci separating these scutes cross respectively the first, third, fifth, and eighth neurals. On each side of these vertebrals is a row of four large scutes, the *costals* (*c. s*, 1; *c. s*, 2; etc.). The sulci between these descend respectively on the second, fourth, sixth, and eighth costal bones.

The borders of the carapace are invested by a series of marginal scutes, twelve on each side (1, 2, 3, etc., on right side). The sulci dividing these from the costal scutes run along near the upper border of the peripheral bones. At the free borders of these peripherals the scutes turn down and appear on the under sides of the bones.

It will be observed that the scutes coincide neither in number nor position with the underlying bones. It is seldom that the sulci follow the sutures. This matter will be discust hereafter.

In fig. 2 are represented the plastral scutes, the characters indicating the names appearing in the right side of the drawing. A median longitudinal sulcus runs from the front to the rear of the plastron, separating the scutes of each pair. In front is a pair of *gular* scutes (*g*); then a pair of *humerals* (*hum*); followed by the *pectorals* (*pec*), the *abdominals* (*ab*), the *femorals* (*fem*), and finally, by the *anals* (*an*). Just behind each axillary notch is an *axillary* scute; while just in front of each inguinal notch is found an *inguinal* scute. The marginal scutes seen in this figure are the same that appear in fig. 1.

We may now examine the vertebræ in front of and behind the dorsals. In all of the turtles there are normally 18 presacral vertebræ, of which 8 belong to the neck. The more anterior and the more posterior cervicals are the shorter. The neck as a whole is about as long as the dorsal series of vertebræ. The first is composite, consisting of four distinct pieces. On each side is a neural arch, aiding in forming the neural canal. Below, these abut on a median piece, the *hypocentrum*. These three bones unite in forming a concavity, into which fits the ball-like occipital condyle. Behind the arches and the hypocentrum is the *odontoid* process, the proper centrum of the first cervical. Behind, this articulates with the centrum of the second cervical but does not become anchylosed with it.

Of the other cervicals the arches are separable from the centra along a line of cartilage. The neural arches are all low and devoid of spines. There are no lateral processes. As regards the articular ends of the centra, there is great diversity. In *Trachemys scripta*, the second and third are convexo-concave; the fourth and the eighth are convexo-convex; the fifth is concavo-convex; and the seventh, concavo-concave. The articulations between the fifth and sixth, the sixth and the seventh, and the seventh and the eighth are extended from side to side and divided medially, forming a true hinge joint, which permits very free motion up and down, but restricts it from side to side. The anterior and the posterior zygapophyses are little elevated above the centra and are placed far apart. These arrangements contribute to free motion in a perpendicular plane, but limit it in a horizontal.

Behind the last dorsal vertebra come two sacrals. Their ribs expand distally and articulate with the upper ends of the ilia. The sacrals are followed by a number of caudals, about 15, but varying with the species, or even in individuals. Most of these have transverse processes.

The skull of *Trachemys scripta* seen from above (fig. 3) presents three pairs of bones which join at the median line. In front are the *prefrontals*, extending backward to the middle of the orbits. The anterior ends roof over the nasal cavity. A strong process descends from each to join the vomer and the palatine, and to form the front wall of the orbit. Behind the prefrontals are placed the larger *frontals*. They aid in forming the rim of the orbits. The *parietals* are important bones, inasmuch as they form the roof and much of the lateral walls of the brain-case. The anterior end of each sends downward a strong process which joins the pterygoid. Besides the pterygoid, the lower border of the parietal articulates with the *prootic* and the *supraoccipital*. The latter bone is greatly prolonged backward, as it is in almost all turtles. It forms a small part of the boundary of the *foramen magnum*.

The *maxilla* bounds the nasal cavity on the side, the orbit below, and its lower border forms an acute cutting-edge. In life this edge is covered with a horny sheath. Posteriorly the maxilla articulates with the *jugal*. The hinder part of the rim of the orbit is formed of the jugal below and of the *postfrontal* above. These two bones form a postorbital bar of moderate width.

A large *tympanic cavity* is excavated in the *quadrate*, an extremely important bone among the reptiles. Below the cavity mentioned, the quadrate descends to form a movable articulation with the lower jaw. In the hinder border of the quadrate is a small, but deep notch for the passage of a long, rod-like bone, the *columella*. Interposed between the anterior border of the quadrate and the jugal bone is the *quadratojugal*. The jugal and quadratojugal form the zygomatic arch. Above and behind the quadrate is the *squamosal*.

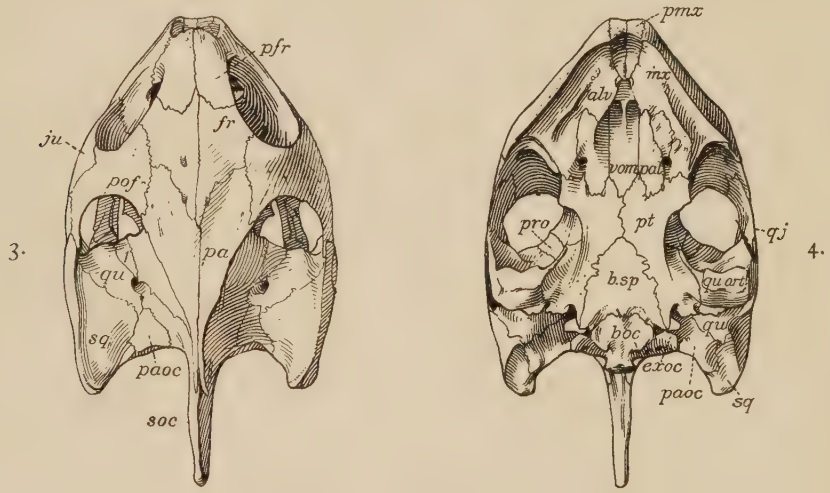
The sides of the hinder part of the skull are occupied each by a long excavation, the *temporal fossa*. The floor of this is formed of the parietal on the inside, of the *prootic* and *paroccipital* in the middle, and of the quadrate and squamosal on the outside.

Fig. 4 represents the skull of the same species as seen from below. In front are the *premaxillæ*, bounding the nasal cavity below and entering into the roof of the mouth. On each side and behind the premaxilla is the *maxilla*. It presents outwardly the cutting-edge already mentioned. Its inner border joins, in front, the *vomer*, posteriorly the *palatine;* the middle portion is mostly a free edge, forming the lateral boundary of the *choana*. Between the two borders is a broad *triturating*, or *alveolar*, surface, which in life is covered with a horny sheath. Along the middle of this, parallel with the cutting-edge, is a sharp ridge, slightly tootht.

The midline behind the premaxillæ is occupied by the single *vomer*. Anteriorly it divides the nasal passages from each other; laterally it articulates with the *palatines;* posteriorly, with the *pterygoids*. The palatines assist in roofing the nasal passages and in forming the triturating surface mentioned. Between each and the maxilla of its side is seen an opening, the *posterior palatine foramen*.

The pterygoids meet each other at the midline anteriorly, but posteriorly are separated by the *basisphenoid*. They extend backward so far as to exclude the bone last mentioned from contact with the quadrates. The lateral border of each pterygoid is mostly a sharp free edge. Behind the basisphenoid comes the *basioccipital*. It is joined on each side by the *exoccipital*, and all three of these bones join in forming the *occipital condyle*. From this view is seen also a portion of the paroccipital and squamosal. On each side of the basicranial axis are seen foramina for the passage of various nerves and blood-vessels.

Each ramus of the lower jaw is composed of six bones. In front is the *dentary*, furnishing the triturating surface of the jaw, covered above with a horny sheath, and



Figs. 3 and 4. *Trachemys scripta.*

3. Skull seen from above. ×1. *fr*, frontal; *ju*, jugal; *pa*, parietal; *paoc*, paroccipital; *pfr*, prefrontal; *pof*, postfrontal; *pro*, prootic; *qu*, quadrate; *sq*, squamosal; *soc*, supraoccipital.
4. Skull seen from below. ×1. *alv*, alveolar surface of maxilla; *boc*, basioccipital; *bsp*, basisphenoid; *exoc*, exoccipital; *mx*, maxilla; *pal*, palatine; *paoc*, paroccipital; *pmx*, premaxilla; *pro*, prootic; *pt*, pterygoid; *qu. art*, articulation of quadrate with lower jaw; *qj*, quadratojugal; *sq*, squamosal; *vom*, vomer.

completely co-ossified with its fellow of the opposite side at the *symphysis*. On the lower border of the jaw this bone extends backward nearly to the articulation with the quadrate. The upper border of the jaw, behind the triturating surface, is formed in front by the *coronoid* bone; posteriorly by the *supraangular*. These two bones are to be seen both from the outside and from the inside of the jaw. Behind the supraangular is a nodular bone that articulates with the quadrate, the *articular*. On the inner surface of the jaw, near the hinder end, are two bones, whose names are in dispute. Baur (Anatomischer Anzeiger, XI, 1896, p. 413) calls the lower of the two the *splenial*, the upper the *angular*. Williston (Science, XVIII, 1903, p. 830) regards the lower bone as the *angular*, the upper as a *dermal articular*. The same author has, in his work on North American Plesiosaurs, 1903, page 30, called the latter bone the *prearticular*, and this name is adopted by the present writer.

The shoulder-girdle of an emyd turtle consists of two bones on each side. One of these, the *scapula*, consists of two slender portions placed at nearly a right angle with each other. The longest portion, the proper *scapula*, the *body* of the scapula,

extends from the *glenoid cavity*, of which it furnishes more than half, upward and inward, to become ligamentously attacht to the upper end of the first costal plate. The other part of this bone extends from above the glenoid cavity inward and forward, to be attacht by ligament to the entoplastron. This process has been variously interpreted, but here it is regarded as the *procoracoid*, which has become co-ossified with the scapula. It will be called the procoracoid process. For a discussion of this subject and a list of writers who have considered it the reader is referred to a paper by Max Fürbringer in Jenaische Zeitschrift, XXXIV, 1900. The other bone of the girdle is the *coracoid*. It starts from the glenoid cavity, and proceeds inward and slightly backward, to approach closely its fellow at the midline.

The writer regards the chelonian limb as belonging to a relatively primitive type. If the reader will peruse Huxley's chapter on the position of the limbs, in his Anatomy of Vertebrated Animals (Appleton's edition, 1872, p. 33), and compare his statements with what he can see in the limbs of a turtle, he will probably agree with the view here presented. The apex of the angle at the elbow, instead of being directed backward, is rather directed forward and upward. There is no crossing of the ulna and radius.

The humerus of the emyd is rather strongly bent in the plane passing through the axes of the three segments of the limb. The head is directed upward. The strongly devélopt tuberosities for attachment of muscles, the *radial*, or *lateral*, and the *ulnar*, or *medial*, are bent toward the lower face of the bone. The ulnar is always the larger. At the distal end of the bone, on the anterior or radial side, is a passage for the radial nerve, the *ectepicondylar foramen*.

Of the two bones of the lower arm the *radius* is the smaller. It has a shallow cavity at the proximal end that meets the articular end of the humerus. Its distal end is expanded and articulates with the *intermedium* and the *radiocentrale* of the *carpus*. The *ulna* is the stouter bone, is flattened, has the suggestion of an *olecranon process*, and articulates distally with the *intermedium* and the *ulnare*.

The carpus is simple. Besides the bones already mentioned as belonging to the carpus, there is another in the proximal row, on the outer side of the ulna. There are 5 bones in the distal row, but sometimes the fourth and the fifth are co-ossified. There are 5 *metacarpals*, each of medium length. The digits are 5 in number, the first and the fifth the shortest. The first digit has 2 phalanges, the others 3 each, exactly as in the Mammalia.

The *pelvis* is broad and short, and each half is composed of 3 bones, all of which take part in the formation of the *acetabulum*. The *ilium* is expanded anteroposteriorly above and is articulated with the outer ends of the sacral ribs. The middle of the bone is slender. Each *ischium* has a posterior process which rests on the xiphiplastron and an anterior process which runs forward to join the pubis of its side. There is thus produced on each side a large heart-shaped fontanel, the ischio-pubic foramen. Each *pubis* has a lateral process which rests on the xiphiplastron. The pubis is prolonged forward considerably, and between the two there is a median notch which in life is filled with cartilage, the *prepubic;* but this does not become ossified.

The *femur* resembles considerably the humerus; but it is a longer bone and there is no perforation corresponding to the ectepicondylar foramen. The head is larger and of different form. The trochanters are of about the same size and the digital fossa separates them far down. The *tibia* is a stouter bone than the *fibula*. Its upper end is the larger and presents a large surface for articulation with the femur. The lower end has a saddle-shaped articular surface to join the large bone forming

the first row of the *tarsus*. The fibula is slender, with the broader end downward, articulating with the same bone as does the tibia. The bone of the tarsus just mentioned is the only one present in the upper row, and is regarded as representing three bones that theoretically belong in the upper row, besides the *centrale*. In the lower row of tarsal bones there are five present, all articulating above with the large bone of the upper row and distally each with one of the *metatarsals*. The fifth of these bones is peculiarly expanded in the turtles.

The 5 metatarsals are rather elongated in *Graptemys* and *Trachemys*, as are, too, the *phalanges*. In the first digit there are 2 phalanges; in each of the others, 3. All the terminal phalanges are invested in horny claws, except the fifth.

THE CHELONIIDÆ. THE SEA-TURTLES.

Some of the salient features of the Cheloniidæ will now be described. These constitute a family of the Cryptodira, a superfamily to which also the Emydidæ belong. The Cheloniidæ are greatly different in some respects from the Emydidæ. The shell is composed of the same elements, but many are less completely developt. In general, the border of the carapace is excavated in front for the neck; and on each side of this for free movement of the fore limbs. Behind, it is pointed, so that in form the carapace is somewhat heart-shaped. The costal plates fall short of reaching the distal ends of the ribs, as a result of which open spaces, or fontanels, are left between the costals and the peripherals. Usually none of the costal plates come into contact with the peripherals. The ribs of the costals, however, reach these bones and each enters a pit in a corresponding peripheral. In the loggerhead (*Caretta caretta*), for example, rib-ends enter peripherals 3 to 8 inclusive and peripherals 10 and 11. In some forms, as *Lepidochelys*, there are supernumerary bones interposed among the neurals, so that the number of these seems to be as high as 14.

The carapace is furnisht with scutes similar to those of the Emydidæ. In *Caretta* and *Lepidochelys* there is a supernumerary costal scute in front of the normal first.

Altho the plastron of these turtles is composed of the same elements as that of the Emydidæ, some of these are greatly modified. The hyoplastra and the hypoplastra are not suturally connected with the peripherals of the bridge; nor do the plastral bones just named come into contact with their fellows at the midline, so that the space between the bones of the right and of the left sides is occupied by a great fontanel. On each side there is another fontanel inclosed by the bridge peripherals, the outer end of the hyoplastron, and that of the hypoplastron. The inner and the outer borders of the two sets of bones last mentioned send out a number of digitations into the fontanels. The epiplastra are saber-shaped bones which join each other and the entoplastron at the midline, without jagged sutures; and their distal ends are applied to the outer border of the corresponding hyoplastrals. The xiphiplastra are narrow, curved bones that approach each other at their distal ends.

Carapaces and plastra similar to those of the Cheloniidæ are found among the Thalassemydidæ, and to these the reader is referred for illustrations.

The neck of the Cheloniidæ is much shorter than that of the Emydidæ and the head can hardly be retracted within the shell. In the loggerhead the neck is but little more than half as long as the series of dorsal vertebræ. The eighth cervical articulates by a synovial surface with the inferior side of the nuchal bone. The series of caudal vertebræ is short.

The skull of the Cheloniidæ differs in some important respects from that of the Emydidæ. In order to illustrate this, figures are here introduced giving upper (plate 1, fig. 1), lower (plate 1, fig. 2), and lateral (plate 2, fig. 1) views of the skull of *Lepidochelys kempi* Garman. These figures were prepared for Dr. George Baur, in 1888, but reverted to the United States Geological Survey, the then director of which, Dr. C. D. Walcott, has permitted them to be used here. No figures of this species have hitherto been publisht. The most interesting feature of the skulls of the sea-turtles is the great extent of the bony roof covering the temporal region. This roof extends from the orbit to behind the plane of the occipital condyle. The postfrontal bone, narrow in the emyds, is carried backward nearly to the hinder border of the roof. The squamosal sends upward and inward a plate that meets a horizontal plate from the parietal, forming a parieto-squamosal arch.

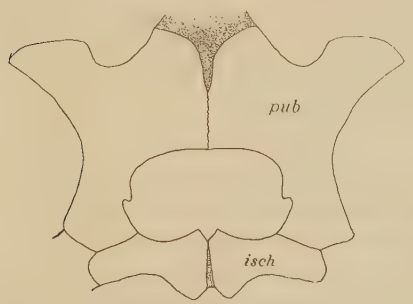


FIG. 5.—*Caretta caretta*. Pelvis from below. $\times\frac{1}{3}$.

The lower side of the skull is interesting chiefly because of the broadening of the triturating surfaces of the jaws. The palatal plates of the vomer extend backward until they meet similar plates from the palatines. The choanæ are thus thrown much farther toward the middle of the skull than in the skull represented by text-figure 4. The crushing surfaces of the lower jaw are correspondingly widened (plate 1, figs. 3 and 4). In the Thalassemydidæ the choanæ may be pusht much further backward, as may be seen by examining the skull of *Rhetechelys platyops* (Cope). There are no posterior palatine foramina.

In the Cheloniidæ the procoracoid process makes an obtuse angle with the body of the scapula, and there is a distinct neck between the process and the glenoid fossa. The coracoid bone is longer than the scapula and moderately expanded at its free end. These bones are represented by fig. 2 of plate 2.

The humerus of these sea-turtles is strongly modified from the primitive form. It is much straighter than that of the Emydidæ and has become flattened in the plane of the distal end. The head and the radial and ulnar tuberosities have changed positions. The head is turned downward and proximad into the plane of the bone, while the tuberosities are lifted into this plane, each on its proper border of the bone. The radial tuberosity is carried along on the shaft of the bone until it has lost its connection with the head. It becomes divided into two parts, one for the deltoid muscle, the other for the supracoracoid. Fig. 3, plate 2, represents the humerus of *Lepidochelys* as seen from above; fig. 4, as seen from below.

Relatively to the humerus, the radius and the ulna are shortened, the ulna more than the radius. In the carpus the radiale remains small, the intermedium and the ulnare are enlarged and flattened, while the centrale is distinct. There are five bones in the distal row, one articulating with each metacarpal. The third and the fourth may be co-ossified. On the ulnar side of the carpus there is a large flat bone assisting to broaden the carpus. It may be regarded as the pisiform.

The second, third, and fourth digits are greatly elongated, the bones flattened, and all are bound together in a mass of muscles and skin to form an undivided oar. The first, and in some cases the second, digit is provided with a claw.

The pelvis of the Cheloniidæ is broad and deprest (fig. 5). The ilia are short; the upper end is slender and turned backward and the axis of the bone is nearly in the plane of the pubes. The latter bones are broad. Between the two, at the

midline in front, there is a deep notch, filled in life by the prepubic cartilage. The lateral processes are broad. The ischia are without posterior lateral processes, and they are not connected with the pubes on the midline by bone; thus the ischiopubic foramina unite into one in the prepared skeleton.

The femur, which in the emyds is longer than the humerus, is, in the sea-turtles, shorter than the latter element. The shaft is not so straight as is that of the humerus and the head is not so much deflected toward the axis of the shaft. The trochanters differ considerably in size and the digital fossa does not descend far between them. The tibia and the fibula are relatively stout bones. While in the emyds described above, the two upper segments of the fore limb are considerably shorter than the corresponding segments of the hinder, the reverse is true in the Cheloniidæ. Figs. 5 and 6 of plate 2 represent the femur of *Lepidochelys*.

The hinder foot of sea-turtles is, compared with the fore foot, greatly reduced. In *Caretta* the hinder foot, including the tarsus, is only about half as long as the fore foot. There are 2 bones in the first row of the tarsus, 5 in the second row.

THE TRIONYCHOIDEA. THE SOFT-SHELLED TURTLES.

We will give our attention now to members of another superfamily, the Trionychoidea, popularly known as soft-shelled turtles, sometimes as mud-turtles, or river turtles. The two last-mentioned names are, however, often applied to other groups of turtles.

In these, as in other turtles, there is a carapace and a plastron; but they differ greatly in appearance from those of the emyds. The whole body is greatly deprest. For illustrations of these portions of the shell the reader may consult the figures of the fossil species on succeeding pages. The carapace is usually composed of neurals, 7 or 8 in number, 7 or 8 pairs of costals, and a nuchal bone. Only in one genus, *Trionyx* (*Emyda* Gray), including two Asiatic species, are there any suggestions of peripherals. The costal bones are closely articulated to their neighbors and the contiguous neurals; but often these costals do not extend to the ends of the ribs; or, if they do, it is only in very advanced age. In life the periphery of the shell is surrounded by a rim of dense and flexible connective tissue, terminating all round in a sharp edge. It is this rim that has suggested the name soft-shell.

The whole upper surface of the carapace is ornamented with a network of ridges which inclose pits of various forms. The size and arrangement of the ridges and pits vary in the different species. There are never any traces of horny scutes, the outer skin always remaining soft.

The plastron in some respects resembles that of the sea-turtles, inasmuch as there are median and lateral fontanels and the connection with the carapace is a ligamentous one. The hyoplastra and the hypoplastra are furnisht with median and lateral digitations. Of the median digitations one belongs to each hyoplastron and is directed forward and inward, to come into contact with the entoplastron. Two belong to each hypoplastron, one being directed toward that of the opposite side, the other toward the xiphiplastron. Of the lateral digitations one set is directed from each hyoplastron forward and outward, the other from the hypoplastron backward and outward. The hyoplastron and the hypoplastron of each side are closely sutured together, in some cases co-ossified.

The entoplastron is V-shaped, the apex being directed forward, an arm resting against the hyoplastron of each side. The epiplastral bones are slender and curved, usually not in contact with each other at the midline. They differ from these bones in all other turtles in being excluded from contact with the hyoplastra by the arms of the entoplastron.

The xiphiplastra are usually more or less curved bones, whose anterior ends interdigitate with the hypoplastra, while their posterior ends meet at the midline.

In some cases the plastral bones are smooth and devoid of ornamentation. In many other cases there are developt on their lower surfaces patches of more superficial bone, the *callosities*. These callosities are sculptured into pits and ridges, somewhat like the bones of the carapace, but the pattern may be different. Each callosity may occupy but a small part of the bone developing it or it may extend over the whole bone. The callosities are more extensive in the Cretaceous and Tertiary species than in those now existing.

The best description of the plastral bones of living Trionychidæ has been publisht by Dr. Friedrich Siebenrock (Sitzungsber. Akad. Wiss. Wien, CXI, 1902, pp. 807–846).

In the Plastomenidæ the median fontanels are filled up; and the whole lower surface of the hyoplastra, hypoplastra, and the xiphiplastra is sculptured.

The neck of the soft-shelled turtles is long and slender, and, like that of the Cryptodira, it bends most freely in a perpendicular plane. In a specimen of *Platypeltis spinifera* at hand all the centra are convex in front, concave behind, except that the hinder end of the eighth is reduced to a thin edge. This cervical is connected with the first dorsal almost wholly by the zygapophyses.

The skull of the soft-shelled turtles presents many distinctive features. Fig. 1, plate 3, represents that of *Platypeltis ferox*, a Florida species, seen from above; fig. 2, plate 3, the same skull as seen from below. The skull is elongated and pointed in front. The posterior region is notable for the three large backwardly directed processes, the supraoccipital and the two squamosal processes. Of the temporal roof there is no part except the postorbital and the zygomatic bars. The prootic extends much in front of the articulation of the lower jaw. The hinder border of the pedicel of the quadrate is closed behind the stapes, so that this occupies a canal, instead of a notch. The premaxillæ have coalesct into a single small bone. Seen from below, the skull presents in front a median prepalatine foramen and the two choanæ. Altho the latter open rather far backward, they are not underfloored by vomerine, palatine, and maxillary plates. The triturating surfaces of this species are rather broad. The vomer is always small. The palatines meet throughout their length at the midline, and posteriorly they articulate with the basisphenoid. The pterygoids are broad, run backward alongside the basioccipital, and do not meet on the median line. The basioccipital and the exoccipitals all take part in the occipital condyle. The paroccipital is a large bone.

The lower jaw (plate 1, fig. 5) is composed of the same elements as that of the emyds. The coronoid bone is large and the angle of the jaw projects considerably behind the articulation with the quadrate.

The hyoid apparatus is strongly developt.

In order to accommodate itself to the flattened form of the body, the scapula is directed from the glenoid fossa upward, forward, and inward, making an angle of about 50 degrees with the procoracoid process (plate 3, fig. 3). The latter is slightly expanded toward its distal end and flattened. The coracoid is broad and flat and somewhat saber-shaped.

The humerus (plate 3, figs. 4, 5) is a stouter bone than that of the emyds above described, and it is less neatly modeled. The proximal tuberosities, the radial and the ulnar, are larger, with a broader fossa between them. The ectepicondylar passage is a groove. The radius is half the length of the humerus; the ulna is still shorter.

The fore foot is as long as the humerus, a condition due to the elongation of especially the median digits. The three on the radial side have claws, the others

do not. The phalangeal formula of the first three digits is 2, 3, 3, as in Emydidæ. The fourth may have 4, 5, or 6, while the fifth finger may have 3 or 4 phalanges.

The pelvis resembles much that of the Cheloniidæ, but the opening representing the united ischio-pubic foramina is larger. The ilium is short and slender and the upper end is turned backward. The ischia have short posterior processes.

The femur (plate 3, figs. 6, 7) is slightly longer than the humerus, which it resembles considerably. It may be distinguisht by its having no ectepicondylar groove and by the narrower, more elongated, head. The trochanters are wide apart and wholly separated by the interdigital fossa.

The tibia is a stout bone nearly three-fourths as long as the femur. As in other turtles, the tibia is a slenderer bone. The hinder foot is still more elongated than the anterior, that of *P. spinifera* being more than a third longer than the femur. The first three digits have the same number of phalanges as other turtles; that is 2, 3, 3. The fourth digit may have 4 or 5 phalanges; the fifth, 2 or 3. The first three have claws.

THE PLEURODIRA. THE SNAKE-NECKT, OR SIDE-NECKT TURTLES.

It is necessary to make some observations on the osteology of the members of another superfamily, the Pleurodira. The shell is composed of the same elements as in the emyds and often presents no important differences from that of the latter. There are genera in which the neurals are reduced in number and a few in which these bones have been wholly suppresst. In a few living genera and in some that are extinct there is present a pair of bones, unknown in the Cryptodira and Trionychoidea, the *mesoplastrals*, interposed between the hyoplastrals and the hypoplastrals. In *Pelusios* (*Sternothærus*) these bones join across the plastron. In *Pelomedusa* they are small triangular bones occupying the middle of the bridge only. The same bones occur in the species of *Baëna;* and the reader may consult the figures under that genus.

The shell of all Pleurodira differs from that of other turtles in forming sutural connections with the pelvis. The eighth costal plates develop each a sutural surface for the upper end of the ilium. On each of the xiphiplastrals are two sutural scars, the anterior for union with the pubis, the posterior for union with the ischium. On other pages will be found figures of the species of *Taphrosphys*, which represent these articulations. In the Pleurodira there is probably always an intergular scute present. Sometimes the gulars meet in front of it.

The cervical vertebræ are, as in all turtles, 8 in number, but they differ greatly from those of the Cryptodira and of the Trionychoidea. In contradistinction to the neck of the latter turtles, that of the Pleurodira is constructed for free flexure in a horizontal plane. This is effected by having the centra joined by ball-and-socket joints and by having the zygapophyses of the two sides placed close together and high above the centra. A description of these vertebræ is given from the neck of *Hydromedusa tectifera.*

The neck is nearly a third longer than the dorsal series of vertebræ. The first cervical, unlike that of the other superfamilies, has all the elements consolidated and is two-thirds as long as the longest. As regards the articular ends of the centra we have the following: The first and the seventh are concavo-concave; the second, third, and fourth are convexo-concave; the fifth and the eighth are convexo-convex; the sixth is concavo-convex. All the cervicals possess well-developt transverse processes, with broad bases. Along the lower side of the centrum of each runs a sharp crest. The postzygapophyses of the first two vertebræ are separated by

only a slight notch; all the others have coalesct. The prezygapophyses are close together, but have not coalesct. Those of the eighth are very small, thus greatly different from those of the members of the other superfamilies.

In some of the other Pleurodira the intercentrum and the odontoid process of the first cervical are distinct from the arches. In the Pelomedusidæ only the second cervical is convexo-convex; all the others concavo-convex.

In none of the Pleurodira is the neck withdrawn into the shell as it is in the other turtles, but is bent sideways and brought under the projecting borders of the shell. In harmony with this action, the anterior bones of the carapace and of the plastron often project farther than in other turtles.

The skull of the Pleurodires offers many peculiar structures. That of *Hydromedusa* may first be considered. This skull is long and very flat. There are distinct nasal bones. The prefrontals do not send down processes to the vomer. There is a postorbital arch, but no zygomatic arch. At the rear there is a very slender palato-squamosal arch. Seen from above the whole upper surface of the pterygoids and the whole temporal fossæ are exposed to view. There is no ridge projecting outward from the parietal over what may be called the *suprapterygoid fossa*, as in other turtles; nor does the prootic project forward over this fossa. The fossa just mentioned is bounded outwardly by the upturned outer border of the broad pterygoids. The premaxillæ are small. The supraoccipital spine is extremely short.

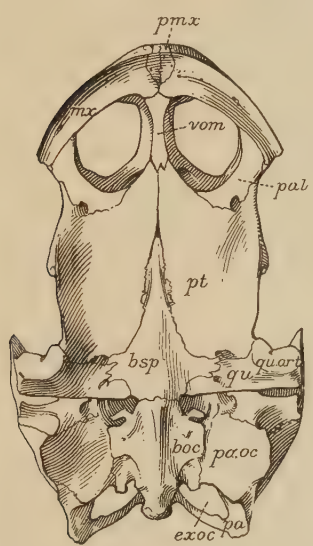


FIG. 6.—*Hydromedusa*. Skull from below. $\times\frac{1}{3}$.

boc, basioccipital; *bsp*, basisphenoid; *exoc*, exoccipital; *mx*, maxilla; *pa*, parietal; *pal*, palatine; *paoc*, paroccipital; *pmx*, premaxilla; *pt*, pterygoid; *qu*, quadrate; *qu. art*, articulation of quadrate with lower jaw; *vom*, vomer.

Fig. 6 represents the skull seen from below. The triturating surfaces of the upper jaw are very narrow. The choanal openings are very large and are separated by the splint-like vomer, which comes into contact with the pterygoids. The latter bones separate widely the small palatines. Behind the latter bones are the posterior palatine foramina. The pterygoids are greatly developt anteriorly and laterally. They are in contact on the mid-line in front, but for more than half their length the basisphenoid bone comes between them. The pterygoids are abbreviated behind, so that they permit the quadrates to join the basisphenoid. This arrangement is characteristic of the Pleurodires and distinguishes them from all other turtles. The quadrate is notcht behind for the passage of the stapes.

The lower jaw is slender and the coronoid processes are low. The articular furnishes a ball for articulation with the quadrate. There is present what Baur called a presplenial, but which is here regarded as the true splenial, a bone absent from most turtles.

The hyoid apparatus is greatly developt, but need not here be described.

The scapula is a strong bone. The procoracoid process makes less than a right angle with the body of the bone. Between the two portions, in the angle, is a sharp crest. The glenoid fossa is at the end of a long neck. The coracoid is relatively short, much bent in a horizontal plane, and expanded at the free end.

The humerus resembles that of the emyds in most respects. The ulnar and radial tuberosities are somewhat larger, the ulnar ascending slightly above the head, the radial descending lower than in the emyds. The ulna has no suggestion of an

olecranon. The tarsus and digits do not differ enough from those of emyds to require further notice here.

The pelvis of *Hydromedusa* differs greatly from that of the emyds and trionychids. The ilia are much expanded and triangular at their upper ends, and have become joined by a rough suture with the eighth costals. The lateral processes of the pubes are stout and are sutured to rough surfaces on the xiphiplastra. The anterior branch of the pubis is slender and joins its fellow at the midline. The ischia are stout bones, sutured to the hinder border of the xiphiplastra. The lower portion of each ischium expands into a great lateral process, which runs forward and inward to join the one from the other side, the whole length of each process being sutured to the xiphiplastron. There is no bony union of the pubes and the ischia along the median line. As shown by Baur (Jour. Morphology, IV, 1891, p. 351) there is, in many Pleurodires, a greatly lengthened prepubic cartilage. It is to be compared with the prolongation forward seen in the pubes of species of *Baëna* and *Chisternon*.

The hinder limb does not differ notably from that of the emyds.

Illustrations are here furnisht of the skull of *Podocnemis expansa*, another Pleurodire, the structure of which in many respects strikingly differs from that of *Hydromedusa*. From plate 4, fig. 1, it will be seen that the temporal region is nearly as completely rooft over as is that of *Lepidochelys* (plate 1, fig. 1). There are no nasal bones and the supraoccipital spine is long. In one feature of the temporal roof this turtle is different from *Lepidochelys*. In the latter the postfrontal bone extends backward nearly to the hinder border of the roof; in *Podocnemis* the postfrontal bone is very small and its place in the roof is mostly occupied by the quadratojugal, which rises over the squamosal, excluding the latter from contact with the parietal (plate 4, figs. 1–5).

Fig. 2, plate 4, represents a palatal view of the same skull. The premaxillæ are of considerable size. The vomer is absent. The triturating surface of the maxilla is broad and furnisht with ridges. The choanæ are restricted. The palatines are broad and meet throughout their length at the midline. The pterygoids, too, are broad, little separated mesially by the basisphenoid, and the outer border of each is turned upward into a scroll-like process. The articular surface of the quadrate, for the lower jaw, is seen to be concave.

Fig. 5, plate 4, shows the same skull viewed from the side.

The lower jaw (plate 4, figs. 3, 4) presents a ball-like articular surface for the quadrate. In front of this are seen the angular, the prearticular, the splenial, and the dentary, the latter consolidated with its fellow at the symphysis and furnisht above with a broad and ridged triturating surface. On the outside of the hinder half of the ramus is the supraangular.

THE DERMOCHELYIDÆ. THE LEATHERBACK TURTLES.

It is necessary now to describe in brief terms the skeleton of the leatherback (*Dermochelys coriacea*), one of the most extraordinary of turtles. It attains a great size and is the most thoroly aquatic turtle that is known (fig. 7). Figures of all portions of the skeleton may be found on the plates illustrating a paper by Paul Gervais on this turtle, publisht in the Nouvelles Archives du Muséum d'Histoire Naturelle de Paris, volume VIII, 1872.

The ribs of this turtle, instead of being consolidated with costal plates that unite edge to edge to form a carapace, are wholly free from one another. The first rib is wholly free from the second, the tenth from the ninth. The only thing that

may be supposed to represent the costal plates is the irregular border of the somewhat expanded ribs. Of the other elements entering into the carapace of an emyd or a pleurodirid, the leatherback possesses only the nuchal bone.

But the leatherback has a carapace peculiar to itself. This is composed of a layer of thin, polygonal bones which are buried in the thick skin of the animal. Of these bones there are 7 rows of larger ones, that appear in the living animal as so many sharp dorsal keels. One of these rows is along the midline; three run along each side. In front, this layer of mosaic-like bones overlies the nuchal. Smaller bones fill up the spaces between the rows.

On the inferior side of the turtle there are 5 rows of similar bones, but the spaces between the rows are not so completely filled as on the upper side. Beneath the skin which supports these rows of bones there is a ring of elongated bones which represent the plastron of more normal turtles. These represent the epiplastra, the hyoplastra, the hypoplastra, and the xiphiplastra. The entoplastron is missing. All these bones are slender and thin, and they surround a vast fontanel.

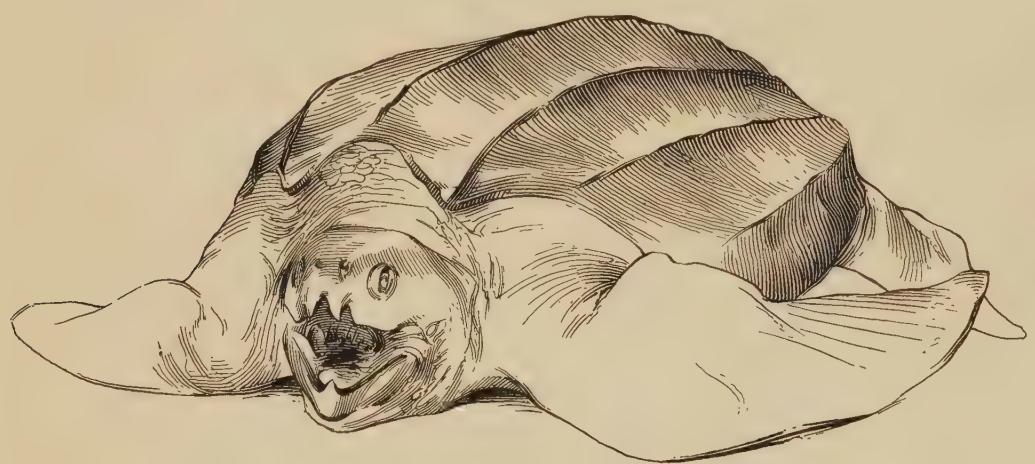


FIG. 7.—*Dermochelys coriacea*. Greatly reduced.

The cervical vertebræ differ in no important respect from those of *Caretta*, and the neck is equally short. The dorsals are ten in number and immovably joined to those in front and behind by rough articular ends. The neural arches are moved forward, so that each articulates about equally with its own centrum and that in advance. They are somewhat expanded above, but do not come into contact with plates from the ribs. In fact, these plates are extremely vestigial. There are two sacral vertebræ, whose ribs articulate with the ilia; and there are about twenty caudals.

The skull at first glance presents many resemblances to that of members of the Cheloniidæ. The temporal roof extends backward as far as the occipital condyle. The postfrontal and the jugal are large, and the squamosal joins the parietal. The supraoccipital spine is short. The prefrontals extend backward to beyond the orbits. The external nares look forward and strongly upward. The maxillæ are not strongly developt; and they have hardly any triturating surfaces. The choanæ are placed far forward and open directly into the roof of the mouth. A splint-like vomer separates them, and extends backward to the pterygoids. The palatines are broad, and they reach forward nearly to the vomer, sometimes coming into contact with it. Thus, they bound the choanæ outwardly. The pterygoids join on the midline for a short distance only in front; otherwise, they are widely separated by the

basisphenoid and the basioccipital; they shut off the latter bones from contact with the quadrate. The inner borders of the pterygoids lie upon the upper side of the basisphenoid.

In one important respect the leatherback and its few fossil relatives differ from all other turtles. This is in the fact that the parietal bone does not send downward, in front of the exit of the trigeminal nerve, a plate to join the pterygoid.

The occipital condyle remains cartilaginous. The pedicel of the quadrate is slender and directed strongly forward. The lower jaw is feebly developt and fitted for soft food. The articular remains cartilaginous. The angular and the supra-angular are short, as seen from the outer side of the jaw, but are prolonged on the inner side. The prearticular and the coronoid are not present.

The parts of the scapula are short and thick. The procoracoid process makes an obtuse angle with the body of the bone. The coracoid bone is about twice as long as the process mentioned, and the free end is somewhat expanded and flattened.

The humerus is a massive bone and much flattened. The general form is that of the humerus of *Lepidochelys*, but the radial tuberosity is brought down to a point more than half-way from the head of the bone to the distal end. The end for articulation with the ulna and the radius is very broad, and nearly semicircular in outline. The ectepicondylar passage is a foramen wholly in the bone, about the middle of its width.

The radius and the ulna are stout bones of about equal length and only about half as long as the humerus. The carpus has 2 bones in the first row, a centrale, 5 bones in the second row, and a large pisiform. Sometimes the fourth and the fifth distal carpals are co-ossified. The digits have the normal number of phalanges; that is, 2 in the thumb and 3 in each of the others. The second, third and fourth digits are greatly elongated, being twice the length of the humerus measured from the head. None of the digits bears a claw. All are bound together in a common envelope of skin to form a powerful flipper.

The pelvis is in many respects different from that of the Cheloniidæ. The form of the ilium and its position with respect to the pubis do not differ greatly from those of the ilium of *Caretta*, but the ischia are broader fore and aft than in *Caretta*. The pubes are connected along the midline for a much greater distance than in the Cheloniidæ. Posteriorly they approach the ischia, so as nearly to join them, the interspace being filled by cartilage. The ischio-pubic foramina are extremely small and nearly separated in the midline. The lateral processes are very large, extending outward and forward, so that at their extremities the pelvis is twice as wide as it is across the narrowest part of the pubes. Each process terminates in a large plate of cartilage. There is likewise a large spatulate prepubic cartilage.

The hinder limb is reduced in size, as in the Cheloniidæ, and offers differences only in detail.

ON THE AMOUNT OF MODIFICATION UNDERGONE BY TURTLES SINCE THEIR EARLIEST APPEARANCE.

On preceding pages a brief exposition has been presented of the principal structures shown in the skeletons of turtles of various groups. It is now intended to consider the differences of structure from another point of view, that of determining the amount of differentiation these animals have suffered since their earliest appearance, especially as compared with the changes undergone by other orders of reptiles. It is generally supposed that turtles have been unusually conservative in their changes; that, as in their movements so in their development, they have progrest slowly. We are to inquire to what extent this impression is true.

Let us first consider the shell, that part which is most often found preserved in the rocks and the part which is regarded as most characteristic of turtles. The theory accepted by the writer is that originally the upper side of the body was protected by a rim of peripheral bones, a median row of neural bones, and eight pairs of bony plates which overlay the ribs and had possibly in the earliest turtle coalesct with them, probably joining one another by their contiguous edges; and that in addition to the bones enumerated, subdermal in their position, there was a more superficial layer of bones, dermal in position and forming seven longitudinal zones, a median or vertebral zone, two costal, two supramarginal, and two marginal zones. The plastron was formed of at least eleven subdermal bones, while superficially there were found five zones of dermal bones, a median and two lateral on each side of it. Starting with this outfit, the vast majority of turtles have wholly or almost wholly divested themselves of the dermal layers and have acquired a solid shell composed of the subdermal bones. On the other hand, the leatherback turtle, *Dermochelys*, appears to have retained the dermal and to have almost wholly surrendered the subdermal bones, for the costal plates now form only unimportant fringes on the ribs; the peripherals and neurals are wholly gone; the nuchal is reduced; and the plastral bones are only eight slender rods. As regards the carapace, *Dermochelys* possesses little that is homologous with that of most other turtles.

If we view the modifications undergone by the shell within the group known as Thecophora we find that they are extensive. We can hardly doubt that the primitive turtles possest a pair of mesoplastral bones; and yet we know that all turtles have discarded these, except a few of the Pleurodira. Within the latter superfamily the shell has not suffered remarkable modifications. Nevertheless, most of the genera have no mesoplastra. In some the plastron is connected with the carapace ligamentously, while in others strong axillary and inguinal buttresses rise from the plastron and articulate with the inferior surface of some of the costals. In all, the hindermost costals have contracted a sutural union with the ilia. In a considerable number of genera the neurals have become wholly suppprest. In *Pelusios* (*Sternothærus*) there is a hinge behind the hyoplastra.

In the superfamily Trionychoidea the shell has undergone extensive reduction. No traces are known of the original dermal layer of bones. The neurals and the costal plates are retained; but the latter show retardation in their development, attaining the distal ends of the ribs not at all or only at a late date in life. The peripherals are wholly missing, except perhaps in the genus *Trionyx* (*Emyda* Gray). In the plastron we never find mesoplastra and all the bones are more or less reduced. In the great majority of cases there are fontanels on the midline and at the bridges. The form and relations of the entoplastron and the epiplastra are very different from those of other turtles, but homologies are easily traced.

It is in the extensive group of Cryptodira that we meet with the greatest number of what may be regarded as the minor modifications of the shell. If we except *Toxochelys*, no known Cryptodire shows more than vestiges of the ancient layer of dermal bones. In some, as *Protostega* and *Archelon*, of the Upper Cretaceous, the costal plates are nearly as much reduced as in *Dermochelys*. In these and a number of other genera of Cretaceous turtles the peripherals are slender, but they persist. Probably the neurals are never wholly absent. The elements of the plastron degenerate in some cases; but, with the exception of the entoplastron of a few genera, all persist.

It is in this group that we discover the greatest variety in the forms of the shell, ranging in convexity from much deprest to highly vaulted and bombous, and from relatively long and narrow to a breadth greater than the length. There may be one or more carinæ on the carapace and its free borders may be smooth or variously notcht or rolled.

In some genera of Cryptodira, as the snappers and the sea-turtles, there are extensive fontanels between the distal ends of the ribs and others at the sides and the middle of the plastron. In most Cryptodira the bones are solidly articulated, abrogating all fontanels. In the snappers and the sea-turtles again, the plastron is only ligamentously joined to the carapace. In other genera, as *Batagur*, *Hardella*, and *Echmatemys*, the plastron sends up powerful axillary and inguinal buttresses to the inside of the carapace. Between these extremes there are all gradations.

Among the Cryptodira there is a great variety of hinges between portions of the shell. In *Cyclemys* there is a hinge between the hyoplastron and hypoplastron, and both these bones are sutured to peripherals. In *Terrapene* there is a similar hinge, with the bones only ligamentously joined to the carapace. In the extinct genus *Ptychogaster* there is a sliding joint between the hypoplastron and the contiguous peripherals. In *Kinosternon* there is a hinge between the epiplastra and the hyoplastra, and another between the hypoplastra and the xiphiplastra. In *Kinixys* there is a hinge in the carapace between the fourth and the fifth costal plates.

Attention may be called to the modifications of the neurals and the costal plates in *Testudo*. The neurals are alternately large and octagonal and small and quadrate. The costals are truncated wedges, placed so that broad and narrow ends alternate both next the neurals and the peripherals.

There are numerous interesting modifications in the number, form, and disposition of the horny scutes of the shell among the turtles. There are supposed to have been originally 12 rows, or zones, of these scutes, corresponding to the 12 rows of dermal bones of *Dermochelys* and the ancestral turtle. A scute coincided with each bone. In each row some scutes grew at the expense of the others and persisted even after the disappearance of its supporting bone. Whole rows of the scutes disappeared, as the supramarginals and the median plastral row of most turtles. The supramarginals are represented in *Macrochelys* by a few scutes over the bridges. The anterior and posterior ends of the supramarginal series are found in the Triassic *Proganochelys*. Many genera furnish the inframarginals, as nearly all the Dermatemydidæ. In the Emydidæ all have vanisht except one in the axillary notch and another in the inguinal. In the Baënidæ, the Dermatemydidæ, and the Pleurodira we find the middle plastral row represented by the intergulars. *Archæochelys* Lydekker and *Polythorax* Cope present more posterior scutes of this row. Between a young *Dermochelys* with its 12 rows of epidermal scutes, with many in each row, and *Terrapene*, with only 7 rows, there are many and interesting stages.

But the Trionychidæ carry the reduction of the scutes to the extreme, for none of the whole superfamily shows any traces of these whatever. In various species of the

other groups the boundaries of the scutes are not visible on the shells; but in most of these cases the scutes were probably very thin and their edges did not impress the bone. In the living *Carettochelys* and the extinct *Pseudotrionyx*, both Cryptodires, there are no scutes.

The principal characters which belong to turtles in general will be given on a succeeding page. Besides these common characters, others that have been lost or modified were possest by the more primitive members of the order. Of these may be mentioned the presence of nasals, of lachrymals, and of an extensive roof over the temporal region. The presence of this roof in the skulls of the older turtles is so general, perhaps rather so universal, that its primitive nature can hardly be doubted. Its frequent presence in the skulls of the lower forms of living turtles and its general absence in the case of the higher forms confirm this conclusion. This roof must have been inherited from the Cotylosaurian ancestors of the order. Otherwise, we must suppose that it was developt during the history of the chelonians and again lost by most of them. It appears obvious that the roof has been reduced in proportion to the elongation of the neck and the ability to withdraw the head beneath the shell. In *Dermochelys* and the Cheloniidæ the roof extends backward as far as the occipital condyle; and all these turtles have short necks and can furnish beneath the shell little protection to the head. In the snappers the roof is moderately developt; in most of the Emydidæ and all the Trionychoidea the roof is reduced to a narrow postorbital bar and to a zygomatic bar. In some species of *Terrapene* and in some other genera the zygomatic bar is missing. While in some Pleurodira, as *Podocnemis*, the roof is wide, in others nothing is left but the postorbital bar. Several genera possess a parieto-squamosal arch (*Rhinemys*, *Hydraspis*, *Hydromedusa*). Dr. George Baur showed the various ways in which these results have been attained. In the Cryptodira the roof has been eaten away from behind forward and in front of the tympanic cavity, severing first the union of the parietal and the squamosal, then that of the postfrontal and the squamosal, and finally in rare cases that of the jugal and the quadratojugal. In the Pleurodira the reduction has followed the reverse course, beginning in front of the tympanic cavity and moving upward and backward. In several genera of Pleurodira there has been left only a very narrow parieto-squamosal bar; in others, not even this. In all cases the removal of the bone has begun at one border or the other of the bone and never by the formation of fontanels in the roof.

In no other order of reptiles do we find such enormous variation in the character of the temporal roof. Superfamilies and families of turtles present modifications that would characterize orders of other reptiles.

The palatal region offers variations in structure that are of wide range. Primitively the choanæ opened in the front of the mouth one on each side of the narrow and shallow vomer. A broadening of the triturating surfaces of the jaws required that the choanæ be pusht backward. This was accomplisht by the development of a median descending plate of the vomer, which spread laterally and joined palatal plates from the maxillæ, the palatines, and sometimes even from the pterygoids. Thus a floor was formed beneath the nasal channels, carrying these backward sometimes more than half-way to the occipital condyle. The process is similar to what occurred in the order of Crocodilia; only, in the most primitive known forms of the latter the choanæ are placed immediately in front of the pterygoids, while in the most advanct forms the choanæ are in the rear of these bones. These differences were regarded by Huxley as sufficient to justify the recognition of two groups of crocodiles, the Mesosuchia and the Eusuchia. Variations of greater extent among the turtles characterize families only or even genera.

The jaws have suffered extensive modifications. In the less differentiated turtles the cutting-edges of the jaws are low and the triturating surfaces narrow. The cutting-edges may become deep, without increase of the width of the triturating surfaces and *vice versa*. For an illustration of great width of the grinding surfaces the reader is referred to the species *Rhetechelys platyops* (Cope).

The lower jaw becomes modified to correspond with the upper jaw. The rami of that of *Toxochelys latiremis* are narrow and slender; while those of *Erquilinnesia* are broad, flat, and fitted for crushing hard objects.

The vomer, which is always developt in the Cryptodira, the Trionychoidea and some of the Pleurodira, is wholly missing in some forms of the latter superfamily.

There is great variation in the pterygoids. The primitive condition appears to be essentially that now found in the Cryptodires in which these bones are of moderate width and extend backward so as to exclude the quadrates from contact with the basicranial bones. This condition exists also in the Amphichelydia and the Trionychoidea. In the Pleurodira the pterygoids have become shortened posteriorly, so as to let the basicranial bones join the quadrates. They have also become expanded, and the outer edge is rolled up in a scroll-like manner.

The necks of turtles furnish us with many interesting features. There is no doubt that in the early turtles the neck was short, perhaps less than half as long as the dorsal series of vertebræ. Doubtless the lengthening has been brought about to facilitate the prehension of food, but it has had other consequences. In some species of each of the superfamilies of Thecophora the neck is considerably longer than the dorsal series, but it has retained its primitive shortness in *Dermochelys* and the other sea-turtles. The elongation of the neck is never due to any increase in the number of vertebræ, but to the lengthening of the individual vertebræ.

The most important modifications of the cervical vertebræ are to be found, not in their mere elongation, but in the structure of their parts. Originally, as we learn from *Glyptops plicatulus*, the vertebral centra were all biconcave. In *Baëna* and *Chisternon* we find the beginnings of differentiation in the articular ends of the centra. The highest stage of differentiation is perhaps to be found in species of *Testudo*. In *Testudo radiata*, of Madagascar, the second cervical is convexo-concave; the third and the eighth convexo-convex; the fourth, fifth, and sixth, concavo-convex; the seventh, concavo-concave. The joint between the sixth and seventh and that between the seventh and the eighth are elongated from side to side and divided into right and left portions, forming true ginglymoid articulations. Variations of this arrangement are found even within the genus *Testudo*. Modifications and less differentiated stages are to be found in other families of Cryptodira.

The necks of the Trionychoidea are usually greatly elongated and the vertebræ are essentially as in the Cryptodira. The Pleurodira do not possess ginglymoid joints, but in at least one genus there are saddle-shaped vertebral articulations, as in birds.

In the development of the mechanisms permitting flexion of the neck two distinct paths were followed, the Athecæ, the Cryptodira, and the Trionychoidea taking the one, the Pleurodira the other. The goal reacht in each case is very different from that attained in the other. In the first case, the neck is bent in a perpendicular plane; in the case of the Pleurodira, in a horizontal plane. As the neck of members of the Cryptodira and Trionychoidea lengthened, the head began to be withdrawn within the shell for protection. In the case of the Pleurodires the neck is bent laterally, and it and the head are protected by the projecting borders of the shell. If the neck is so long that it would carry the head beyond the axilla it is bent first in one direction, then in the other.

To permit these different modes of flexion the mechanical arrangements must be different. In the Cryptodires and the trionychids there are ginglymoid joints at the base of the neck, facilitating bending in a perpendicular plane. The neural arches are low, with the zygapophyses wide apart, favoring motion in the vertical plane, restricting it in the horizontal. In the Pleurodires the arches are high, the zygapophyses close together, often confluent, and at least one end of most of the centra semiglobular, arrangements aiding motion in a horizontal plane.

It is doubtful whether there is another group of vertebrates that possesses so many modifications of the cervical vertebræ as are found in the turtles.

There has occurred a considerable amount of modification in the pelvis of these reptiles. As shown by *Glyptops*, of the Jurassic, and *Baëna* and *Chisternon*, of the Bridger, the pelvis was not originally suturally joined to the shell. In both the Cryptodires and the trionychids the pelvis has retained its original freedom. In the Pleurodires the ilia effected, before the close of the Cretaceous, strong sutural connections with the hindermost costal plates; while the ischia and the pubes became closely sutured with the xiphiplastra.

In the Amphichelydia the ischia and the pubes are joined along the midline by a bar of bone, thus defining right and left ischio-pubic foramina. In the Baënidæ, so far as known, and possibly in *Glyptops*, the prepubic process was strongly ossified. In the Emydidæ and the Testudinidæ the ischio-pubic bar is ossified; but in the Cheloniidæ and the Trionychoidea this region is wholly cartilaginous. That the primitive condition of the ischio-pubic bar and of the prepubic process in the Amphibia and the early Reptilia was cartilaginous we can not doubt. That these should be ossified in the Amphichelydia is remarkable. It suggests that the cartilaginous condition in so many living tortoises may be due to degeneration.

The limbs of most swamp-loving turtles present primitive conditions of the reptilian limb, both with respect to their composition and their disposition. The segments of the limbs are mostly flext in one plane, and this plane stands more or less at right angles with the axis of the body. The apex of the angle at the elbow is directed forward, rather than backward as in the mammals, and the ulna and the radius do not cross. There have occurred few unions of bones and these are confined to the carpus and the tarsus. No bones have suffered important reductions or modifications. In the limbs of swamp-inhabiting turtles there have been few changes since Jurassic times; and, since the Amphichelydia, the Cryptodira, and the Pleurodira possess similar limbs, it is evident that the primitive turtles possest limbs not greatly different.

From this simple type of limb there has been divergence in two directions; one to adapt the animal for life on the land, the other for habitual life in the water. The highest expression of the former adaptation is perhaps to be found in the limbs of species of *Testudo*. In these the principal modification in the proximal bones of the limbs is the drawing downward and toward each other of the tuberosities of the humerus. Most important is the shortening suffered by the bones of the digits and the reduction of the number of phalanges in each to no more than two. The fifth hinder digit may become vestigial. The result of these changes is the production of a short foot resembling that of an elephant and adapted for travel over rough and hard ground.

To fit the animal for habitual life in the water the anterior limb tends to be converted into a flipper. First of all, the fingers become elongated to support a broad web. Usually the number of phalanges remains unaffected. In the Trionychidæ some of the digits are much elongated and the phalanges are more numerous than the normal, and two of the claws have disappeared. In the sea-turtles,

never coming on land except to deposit their eggs, the fore limbs have become transformed into definite flippers with the fingers elongated and all bound together in a common mass of skin and muscles. Only one or two claws remain. The phalanges and carpals are considerably flattened, as is also the humerus. The latter also becomes straighter and the insertions of the deltoid muscle descend on the shaft. While these changes progrest the hinder limb became relatively smaller and fitted for steering the animal. The extreme of these modifications is to be seen in the limbs of the leatherback, *Dermochelys*. Between the short club-like foot of *Testudo* and the long and powerful flipper of *Chelonia* and *Dermochelys* there is a vast interval.

Amid all the changes that have occurred in the turtles certain fundamental structures have remained unaffected. The jaws have always retained their horny covering. The quadrate has remained fixt. The cervical vertebræ have kept unchanged their number, 8, and the dorsals their original number, 10. All four of the limbs have persisted and all the segments of each.

A consideration of the changes which turtles have undergone and a comparison of these with the modifications suffered by other groups of reptiles lead to the conclusion that no other order of these animals, except the Squamata, can display such a variety of structures. The Squamata, embracing the mosasaurs, the lizards, the chameleons, and snakes, have undoubtedly, in adaptation to different modes of life, diverged in more directions and gone farther than have the turtles. The skull has become modified in more ways; the vertebræ, at least as regards the number in the column, have varied more; the limbs have undergone more varied adaptations for walking, for climbing, for grasping, for swimming, for leaping; and in the whole group of snakes and in many lizards the limbs have wholly disappeared. To these denizens of the earth, swarming since probably the Triassic, the turtles must yield in variety of form and structure and habits, but probably to no other order of reptiles.

ON THE PRIMARY AND THE SECONDARY CHARACTERS OF TURTLES.

It may be interesting and productive of some useful result to endeavor to separate the osteological characters that belonged to the most primitive turtles from those that may be called the secondary characters, those that have been acquired in later times through the exaggerated development or reduction or the suppression of certain parts of the skeleton or their modification of form and connections, in order to adapt them to new uses. We will, as heretofore, consider first the shell of the turtles.

As already stated, the writer holds the view that the earliest turtles possest practically two kinds of shell, one purely dermal, consisting of probably a mosaic of small bones arranged in at least 12 longitudinal zones. Each zone probably consisted of a row of larger bones, bordered on each side by smaller ones. It is not necessary to suppose that the spaces between the zones were wholly occupied by these smaller bones. Each of these bones was covered by a horny scute. The nearest approach to such a dermal shell is in our days seen in *Dermochelys*, as has already been stated.

Beneath the skin there seems to have existed a carapace more or less complete which consisted of a nuchal, a median row of neurals, 8 pairs of costals, a pygal, probably one or more suprapygals, and about 11 peripherals on each side. To what extent the neurals and the costal plates had become anchylosed to the neural spines and the ribs respectively it is now impossible to determine. Nor can we say to what extent the various elements of this carapace had become connected with one another. The existence of the dermal carapace would appear to indicate that the subdermal box was not yet closed.*

There was a subdermal plastron that was composed of at least 11 bones. Portis has described *Polysternon*, which had an additional pair of bones between the hypoplastra and the xiphiplastra, making 13 all together. Between these various bones there may have existed more or less extensive fontanels.

According to the author's views, as time went on the external, mosaic-like shell disappeared in most turtles, while a more efficient armor was developt out of the subdermal elements. In the ancestors of *Dermochelys*, however, the dermal armor was retained, while the more deeply seated one disappeared, with the exception of the nuchal bone.

It is proper to state that all authors do not hold that *Dermochelys* has descended to us in a direct line distinct from other sea-turtles, but has been derived from them at a more recent date. On this subject the reader must consult the papers of Baur, Boulenger, Case, Dollo, E. Fraas, Hay, Van Bemmelen, and Wieland.

Most Thecophore turtles have lost the bones of the outer dermal shell. There are yet traces of it perhaps in the dorsal and ventral keels of various turtles, in the tubercles that diversify these keels, and especially in the rows of horny scutes that had their origin from these dermal bones. In one turtle, however, *Toxochelys*, of the Upper Cretaceous, there are yet remains of the dermal armor in the shape of a row of bones along the dorsal median keel. For a description and illustrations of these the reader must consult later pages of this work.

In a paper written in 1898 (Amer. Naturalist, XXXII, p. 929) the writer denominated such bones as the nuchal, the peripherals, and suprapygals as "fascia bones." This was done simply to distinguish them from more superficial bones, called dermal. In a recent paper Mr. H. H. Newman (Biol. Bull. X, p. 74) has referred to this paper and has insisted that the nuchal is a dermal bone. Such it doubtless

*For Dr. George Baur's latest views regarding the primitive condition of the carapace and plastron of the turtles see Anatomischer Anzeiger, XII, 1906, p. 567.

originally was, but it is now overlain by the dermal mosaic. Mr. Newman holds also that the peripherals and the suprapygals are dermal bones, not what the writer called fascia bones or subdermal bones. If the reader will consult the succeeding pages that deal with *Toxochelys* he will see that one of the dermal nodules overlies the second suprapygal. The latter is therefore not equivalent to the row of nodules in front of it and to those on the tail of the snapping-turtle, but is a bone of a deeper layer.

We may, therefore, for the present regard the characters of the most primitive turtles as having been the following: There was a superficial armor composed of dermal bones arranged in at least 7 zones above and at least 5 zones below, with many bones in each zone, and each bone covered by a horny scute. Beneath this was a subdermal armor. On the upper side of the body, this consisted of the nuchal, a row of neurals, 8 pairs of costal plates, suprapygals, and peripherals; below, of the entoplastron and at least 5 pairs of subdermal bones. There were 18 presacral vertebræ, of which 10 belonged to the trunk and were without transverse processes and more or less immovably joined to each other and to the ribs and neural plates. The neck was short and consisted of 8 biconcave vertebræ, which possest transverse processes and low neural spines. There may possibly have been present some cervical ribs. There were 2 sacrals. The tail consisted of biconcave vertebræ, each provided with free ribs, with chevron bones below, and perhaps with one or more rows of bony nodules above.

The skull had a complete temporal roof, but the temporal fossa was probably not widely open behind. There were nasals, lacrimals, and prefrontals, all distinct from one another. There was no parietal foramen. A vomer was present but no prevomers. The choanæ opened far forward in the roof of the mouth. The quadrate was fixt, somewhat excavated to form a tympanic cavity and notcht behind for the stapes. Probably the palate was closed by the union of the pterygoids with each other and with the basisphenoid. The parietals may or may not have sent down each a plate to the pterygoid, in front of the exit of the trigeminal nerve. The paroccipitals were free from the exoccipitals. The jaws were without teeth and were covered by a sheath of horn. Each ramus of the lower jaw was doubtless composed of 7 elements, and the dentaries were probably not co-ossified at symphysis. The outer surface of the bones of the skull was covered by horny scutes. The shoulder-girdle consisted of a pair of coracoids, a pair of scapulæ, and a pair of procoracoids; the latter probably co-ossifying somewhat late in life with the scapula. Limbs, fore and hinder, probably not greatly different from those of living Chelydridæ, but more crudely modeled. The phalangeal formula was 2, 3, 3, 3, 3 in all the feet.

If the views exprest above regarding the original composition of the armor of turtles is correct, the possession of a carapace consisting exclusively of a mosaic of dermal plates, as in *Dermochelys*, is a secondary character; as is likewise the possession of a shell constituted only of the deeper elements, as in the great majority of turtles. Other secondary characters are the absence of entoplastron (*Dermochelys*, *Kinosternon*), the absence of peripherals (*Trionychoidea*), and the absence of mesoplastra, as in most living turtles. Such too is the lack of nasals and lacrimals in the great majority of turtles. The adaptation of the limbs for habitual swimming is, of course, a secondary modification of these organs.

In this category, too, belong those modifications of the cervical vertebræ by virtue of which the neck has become so greatly elongated in most forms and made most freely flexible in a horizontal plane in the Pleurodira and in a perpendicular plane in all the others. Most extraordinary of all the secondary characters is that complex of modifications which permits the head and neck to be retracted between the scapulæ, the loop in the neck sometimes reaching backward quite to the pelvis.

THE CLASSIFICATION OF THE TURTLES.

It is not the purpose of the writer to give here an account of the various schemes of classification that have been proposed by writers on the turtles. For such an account the reader may consult the third part of the sixth volume of Bronn's Klassen und Ordnungen des Thierreichs, beginning with page 347. The following is the arrangement of suborders, superfamilies, and families accepted by the writer.

All of these families, except those in italics, have fossil representatives.

ORDER Testudines.
SUBORDER I. Athecæ.
FAMILY. Dermochelyidæ.
SUBORDER II. Thecophora.
SUPERFAMILY 1. Amphichelydia.
FAMILIES. Pleurosternidæ, Baënidæ, Plesiochelyidæ?
SUPERFAMILY 2. Pleurodira.
FAMILIES. Bothremyidæ, Pelomedusidæ, Chelyidæ, Miolanidæ.
SUPERFAMILY 3. Cryptodira.
FAMILIES. Thalassemydidæ, Toxochelyidæ, Desmatochelyidæ, Protostegidæ, Cheloniidæ, Tretosternidæ, Chelydridæ, Dermatemydidæ, *Platysternidæ*, *Kinosternidæ* Carettochelydæ, Emydidæ, Testudinidæ.
SUPERFAMILY 4. Trionychoidea.
FAMILIES. Plastomenidæ, Trionychidæ.

The arrangement and names of the suborders and superfamilies above given are the same as those used by Mr. George A. Boulenger in his Catalogue of the Chelonia of the British Museum, 1889. Mr. Richard Lydekker employs practically the same groups in his Catalogue of the Fossil Reptilia of the British Museum, part III, 1889; but to some of his groups are given different names. Dr. Louis Dollo, of Brussels, also divides the turtles into the two suborders Athecæ and Thecophora. Altho this eminent writer believes that *Dermochelys*, the only living representative of the Athecæ, was derived from the Cheloniidæ, he separates it as the representative of a distinct suborder on account of its extreme modifications of structure. It was Cope who first proposed to make this turtle the type of a distinct suborder.

In his Bibliography and Catalogue of the Fossil Vertebrata of North America, 1902, the present writer assigned to the Trionychoidea, under the name Trionychia, the rank of a suborder. A further consideration of the subject has convinct him that these turtles should rank lower than a suborder; not higher than a superfamily. Indeed, they appear to have brancht off from the earliest Cryptodira; but their lineage is so ancient, and they have undergone so many modifications of structure, that they are of equal rank with the Cryptodira. The skull is more like that of the Cryptodires than that of the Pleurodires, but has developt peculiarities of its own. Like the Cryptodires, the temporal roof has never been eaten away from below, and always a zygomatic arch remains. The neck is wholly cryptodiran in its modifications and is retracted within the shell in the same way. This is a feature unique among animals, and it seems improbable that it could be hit upon independently by two distinct groups of turtles. The pelvis in its parts and its relationships to the shell is entirely cryptodiran.

Ernst Haeckel, in his Systematische Phylogenie der Wirbelthiere, 1895, page 326, has taken the position that the Trionychoidea had probably arisen already in the Triassic and that they are to be lookt upon as the group from which all the Thecophora have been derived. That the group was establisht even in the Trias is possible; that it gave origin to the other groups of Thecophora seems quite impos-

sible. None of the superfamily has nasals, lacrimals, or temporal roofing. Their derivatives must have acquired these bones. The neck is most completely of all turtles adapted for retracting the head within the shell. To give origin to the neck of the Pleurodires this neck must have lost its peculiar mechanisms and acquired those of the side-neckt or snake-neckt turtles. To have produced the neck found in the Amphichelydia, that of the Trionychoidea must have shortened greatly and have changed its biconvex and its concavo-convex vertebræ into biconcave ones. The Amphichelydia, the Cryptodira, and the Pleurodira must have developt peripheral bones, instead of inheriting them from their ancestors. The Amphichelydia and many Pleurodires did not inherit their mesoplastral bones, but acquired them independently. The limbs of those Thecophora that are fitted for walking must, according to the scheme of derivation proposed by Haeckel, have been evolved from feet fitted for swimming. Turtles endowed with a covering of horny scutes came from a race which are wholly devoid of these coverings. All these procedures are the exact reverse of what is generally believed to be the course followed by animals in their evolution. If it be claimed that the Trionychoidea of that early time possest nasals, lachrymals, and a temporal roof, that the neck was yet short and composed of bicœlous vertebræ, that they had peripheral bones and mesoplastra, then they were not Trionychoidea at all, but Amphichelydia or something very close to them.

It is a difficult matter to estimate properly the relative rank of the three superfamilies of the Thecophora—the Pleurodira, the Cryptodira, and the Trionychoidea. As to the Amphichelydia, there can be no doubt that this group ranks below all the others and that from it have been derived all the others. It appears that the Pleurodira are usually regarded as the most specialized turtles. There is no doubt that the skull and the pelvis have departed farther from those of the Amphichelydia than have those of either the Cryptodira or the Trionychoidea. The most important modification in the skull is the posterior shortening of the pterygoids, whereby the basisphenoid is permitted to join the quadrate. Likewise the outer anterior border of the pterygoids has become rolled up in a peculiar manner. On the other hand, the skull of a number of genera has retained the nasals and the posterior notch in the quadrate, both primitive features. It seems to the writer that the neck is less specialized than that of the Cryptodira and Trionychoidea. The shell has undergone far less specialization than that of the other groups mentioned, many of the genera retaining the mesoplastra, elements unknown in the others. On the whole, the writer is inclined to place the Pleurodira below both the Cryptodira and the Trionychoidea.

As regards the Trionychoidea, it is believed that the skull has departed further from the amphichelydian pattern than has that of most of the Cryptodira. This is seen in the universal reduction of the temporal roof to narrow postorbital and zygomatic arches, the backward prolongation of the squamosal processes, and the closure of the stapedial notch in the quadrate. Altho the articular ends of the cervicals present, so far as is known, less variety of form than in the Cryptodira, the neck is, as has been said by Boulenger, more perfectly adapted for complete and rapid retraction than in any other chelonian. The carapace has become greatly specialized through degeneration of the peripherals and of the horny scutes. The limbs have become moderately specialized for swimming. The Trionychoidea can hardly rank below the Cryptodira; it is convenient to let them, in a scheme of classification, follow the group just mentioned.

In fig. 8 an attempt has been made to indicate the connections between the different families of turtles. This chart differs in some respects from the one publisht by the present writer in the Bulletin of the American Museum of Natural

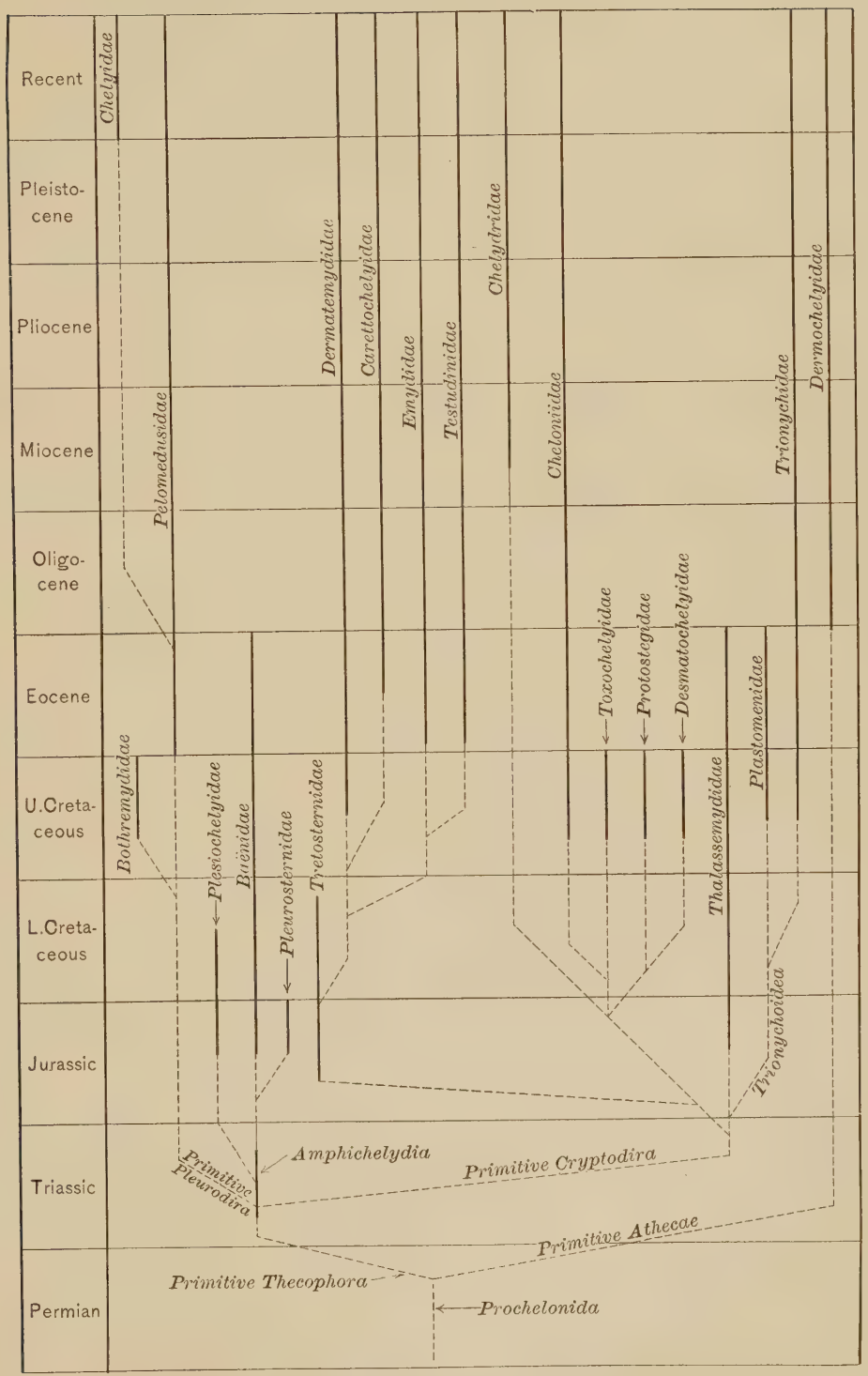


FIG. 8.—Phylogenetic chart showing supposed relationships of the families and higher groups of turtles.

History, volume XXI, 1905, page 167. Since the publication of that paper discovery of new materials has shown that *Anosteira* belongs among the Dermatemydidæ. The family Bothremydidæ, recognized in the present work, is represented in the chart as springing from ancestral Pelomedusidæ during the Lower Cretaceous. It is wholly possible that *Taphrosphys* itself belongs to the Pelomedusidæ, instead of the Bothremydidæ. It has been concluded that the stock that gave origin to the Emydidæ, and the Testudinidæ ought to be brought into closer connection with the Dermatemydidæ. The Carettochelyidæ also are represented as arising from the Dermatemydidæ. It is not improbable that they should have been regarded as direct descendants of the Tretosternidæ.

The geological distribution of the families will be considered on a coming page.

THE DERIVATION OF THE ORDER OF TURTLES.

At the present day the most interesting and the most difficult questions that confront the student of any group of animals or plants are: From what lower group was this derived? and: What are its relationships to kindred groups? We must here at least make the inquiry: From what lower order of reptiles have the turtles been derived? and the further inquiry: What are the relationships of this order to other orders of reptiles? The reply must be: We can not yet give definite answers to these questions.

Nevertheless, some progress appears to have been made toward framing answers to these inquiries. It is quite generally agreed that the Cotylosauria or closely related forms, known from remains occurring in Permian deposits, are the lowest, the least differentiated, of all reptiles hitherto discovered, having themselves been derived directly from the Stegocephalia. On this point see Baur (Anat. Anzeiger, XII, 1896), Cope (Proc. Amer. Philos. Soc., XXX, 1892, p. 279), Osborn (Mem. Amer. Mus. Nat. Hist., VIII, 1903, p. 456), Woodward (Vert. Palæontology, 1898, p. 144), Broile (Palæontographica, LI, 1904, p. 106). From the Cotylosauria, Baur derived the turtles thru rhynchocephalian ancestors, animals not distantly related to *Sphenodon*. Cope concluded (Proc. Amer. Philos. Soc., XXXV, 1896, p. 124) that the cotylosaurian Otocœlidæ, which he afterward removed to the order Chelydosauria (Syllabus of Lectures, 1898, pp. 54, 61), were the source of the turtles. Osborn, as cited (p. 465), brings the line of descent of the turtles from the Cotylosauria through the Anomodontia. Woodward, as cited (p. 170), calls attention to the apparent relationships between the turtles and the Anomodontia, in which group he includes the Cotylosauria and the Chelydosauria. Case has publisht a paper (Jour. Geology, XIII, 1905, p. 126) in which he describes a species of *Diadectes*. In this communication he shows that the family of Diadectidæ is to be transferred to the Chelydosauria; and he demonstrates that there are many resemblances between the skull of his specimens and that of turtles. He holds that we have in the Diadectidæ "forms very closely related to the ancestral stem of the turtles, which tell us much regarding the development of the Testudinata directly from the Cotylosauria."

The Cotylosauria and the closely related Chelydosauria indicate their eligibility to stand as the ancestors of the turtles by the possession of a complete roof over the temporal fossa, by the character, rare among reptiles, of having 18* presacral vertebræ, by the existence of digits having the phalangeal formula, 2, 3, 3, 3, 3. Case has shown that the claims of the Diadectidæ for the honor of the ancestry of the turtles are superior to those of the Cotylosauria, as limited by him, inasmuch as

*Broili states that in *Labidosaurus hamatus* there are at least 24 presacral vertebræ.

in *Diadectes* the temporal roof is notcht where applied to the quadrate and the latter is excavated to form a tympanic cavity; instead of a pair of prevomers, there is a single vomer; and there is a sort of carapace composed of bony plates overlying several pairs of the ribs.

It seems evident that we are getting close to the base of the phylogenetic tree of the chelonians; but, likewise, that we have not yet reacht it. Taking into consideration the fact that no turtle possesses a temporal fenestra, that when the temporal roof is deficient either the zygomatic arch or the parietal arch or both are missing, it seems impossible to derive the turtles from any group of reptiles in which even the beginning of such fenestræ has been made. If this view is correct, there are excluded at once from the chelonian ancestry all those reptiles belonging to Professor Osborn's Diapsida and all the Anomodontia, limited so as not to include the Cotylosauria. The Diadectidæ, too, would be excluded, if they really possest temporal fenestræ. If the presence of a pair of prevomers, instead of a vomer, has the importance attributed to it by some recent authors, the Cotylosauria, as limited by Case, would have to forego their claims. Of known reptiles we appear to be limited to the Diadectidæ and the Otocœlidæ, in our search for the ancestors of the chelonians.

It is improbable that any of the reptiles of the Permian of Texas or equivalent deposits were the ancestors of the turtles. When we consider that already in the Upper Trias the turtle *Proganochelys* possest a typical shell, we must conclude that the earliest of the race must have been in existence as early as the Permian itself. It is, of course, possible, indeed quite probable, that some earlier, less differentiated form of one or the other of the two families just mentioned gave origin to the most primitive turtles.

It is a serious objection to any of the Cotylosauria, using the name in the wider sense, that have been mentioned as possible ancestors of the turtles, that they appear to have possest no ventral armor. Almost certainly the turtles inherited this portion of the shell, in some form, from the Stegocephalia. The *Diadectes* described by Case presented no traces of a plastron, or of abdominal ribs. There are various other reasons why this reptile can not pose as the founder of the chelonian line. Among these are the elevated spines of the vertebræ, the great amount of motion between the several dorsal vertebræ, their complex structure, the anchylosis of the sacrals, and the fact that the plates of the carapace lie between the scapula and the ribs. In turtles the scapula lies inside, not outside, of the costal plates.

Dr. O. Jaekel, of Berlin, has described (Neues Jahrb. Min., 1, 1902, p. 127) an interesting genus named by him *Placochelys* and regarded by him as standing in ancestral relations to the turtles. The body of the animal is short and broad, and is covered by an armor of thick small plates, all closely joined. There is no ventral armor. The specimen was found in the lower portion of the Keuper. The well-preserved skull shows that there were large supratemporal fenestræ and that the nasal openings were separate and far behind the end of the snout. These structures, especially the first named, make it improbable that this reptile is at all closely related to the turtles.

The discovery of *Otocœlus* and *Diadectes* and *Placochelys* is like the capture of so many stragglers and deserters from an army of heterogeneous composition. From these prisoners we may learn something of the personnel and the equipment of that army; but it would be unsafe to draw from the data obtained too wide conclusions. From *Placochelys* we learn that in Triassic times there were broad and short bodied reptiles of tortoise-like form and covered with an armor of small plates. From *Diadectes* and *Otocœlus* we discover that in Permian times there were more

elongated reptiles, in the skulls of which there were many chelonian characteristics and whose bodies were protected by an armor of elongated plates overlying the ribs. The stegocephalian genus *Archegosaurus*, of the Permian, possest a ventral armor of elongated plates. We may confidently expect that in the Permian there will yet be found an animal possessing such a combination of these characters, together with other features, that we can recognize in it the ancestor of the order of turtles.

As to the relationships of the turtles to the orders of reptiles, other than the Cotylosauria, only a few words can be said. The opinion is generally maintained that their relationships are closer to the Plesiosauria than to any other order. Baur (Jour. Morphology, 1, 1887, p. 98) has enumerated a number of resemblances between the two groups. Among other things, he states that the pelvic arch of the Nothosauridæ, among the most primitive of the Plesiosauria, is only comparable with that of the Testudinata. It may be remarked that the pubes in both the turtles and the plesiosaurs are greatly expanded forward and laterally. The ischia are not so much alike, those of the plesiosaurs being much more extended backward than those of the turtles. Baur says that in the humerus of the lower Plesiosauria there is an ectepicondylar foramen; but, according to Fürbringer, there is only an entepicondylar foramen. Baur does not compare the skulls of the two orders. The strongest argument in favor of the relationships of the two orders is found in supposed resemblances in the shoulder-girdles. Probably the best presentation of this is to be found in Fürbringer's elaborate paper in the Jenaische Zeitschrift, XXXIV, 1900, page 326. In that treatise the author takes the ground that the process directed interiorly and inwardly from the scapula in the turtles is a procoracoid, a view adopted by the present writer. Fürbringer also holds that the procoracoid was present in the Plesiosauria. This opinion has been accepted by some authors and disputed by others. To the present writer the tract of bone in question appears to be simply an extension forward and mesially of the scapula, whether that extension is regarded as an acromion or a "ventral ramus" of the scapula. The tract advanct gradually from the scapula to the midline, and there is no evidence that it ever was a distinct bone. The fact that the two clavicles do not lie between the ends of these processes does not appear to be decisive, for in numerous reptiles the clavicles extend laterally on the scapulæ. Opposed to the idea that there are any special relationships between the turtles and the plesiosaurs are the facts that the latter always possess large supratemporal fenestræ, the former never; and that the most primitive plesiosaur, *Lariosaurus*, has the digital formula belonging to the Diapsida and not that of the Synapsida.

At best, the relationship between the turtles and the plesiosaurs is not close; and the most that we can say is that possibly the cotylosaurian stocks of the two orders were a little closer to each other than to stocks that gave rise to the other orders.

THE GEOGRAPHICAL DISTRIBUTION OF LIVING TURTLES.

At the present day turtles exist in all the larger divisions of the earth, wherever there is sufficient heat, at least a moderate amount of moisture, and a supply of food. They occupy too all the warmer seas. Fig. 9 is an outline map that includes all the lands and seas in which these reptiles are found. The areas occupied by the land and fresh-water forms are indicated by parallel rulings, except that certain small islands are made black; but no attempt has been made to show the distribution of the marine species. Their realm may be taken as comprising all the seas between the ruled areas. This map and those succeeding it have been compiled with considerable care; but it is not possible in all cases to determine exactly the limits of the groups.

A glance at fig. 9 will show at once the great influence of heat and cold and the lack of moisture. In western Europe, warmed by the sea, the turtles are represented by a species which ranges nearly as far north as St. Petersburg; while in Central Asia none is known to occur north of Turkestan and the Himalaya Mountains. The southern portion of Arabia and the greater portion of the Sahara Desert are without turtles, on account of the dryness of the climate. In North America the high and cold range of the Rocky Mountains supports no chelonian life. On account of its dryness, the western coast of South America has no turtles; and the southern extremity of the continent none, on account of its coldness. So much can we say with regard to turtles in general; but when we come to study the different groups we shall find that they are often absent from regions where the conditions appear to be wholly favorable for their existence.

FIG. 9.—Map showing geographical distribution of living turtles, excepting those strictly marine. Occupied areas ruled with parallel lines, except some small islands, which are in solid black.

Fig. 10 is intended to display the distribution of the Cryptodira. It is seen to differ from the previous map principally in that it shows that Australia possesses no representatives of the superfamily.

FIG. 10.—Map showing geographical distribution of the Cryptodira.

The absence of Cryptodira from Australia is evidence that that region has for many geological ages been cut off from the regions to the north of it. It appears certain that had the turtles of this superfamily once gained access to this region they would have flourisht there. In numbers the Cryptodira exceed today all other

groups of turtles combined. Accepting the genera and species as described by Mr. George A. Boulenger in his Catalogue of the Chelonians, there are 30 genera of Cryptodira with 140 species; 21 genera of Pleurodira, with 24 species; 6 genera of Trionychidæ, with 24 species. The headquarters of the superfamily is North America.

FIG. 11.—Map showing geographical distribution of the Chelydridæ. Portions of the western hemisphere and the island of New Guinea.

Fig. 11 shows the distribution of the Chelydridæ. The northern limits of the family are somewhat uncertain. The same species, *Chelydra serpentina*, that occurs in Canada, is found also in Ecuador, South America. Until recently it has been supposed that the members of this family are confined to the New World; but J. Douglas Ogilby has reported (Proc. Roy. Soc., Queensland, XIX, 1905, p. 11) the discovery of a new genus and species, *Devisia mythodes*, in the Fly river, New Guinea, the river that has furnisht likewise the remarkable turtle *Carettochelys*. The New Guinea snapper has a length of 860 mm., the carapace being 330 mm. long. This distribution of the snappers is even more remarkable than that of the camels and tapirs.

FIG. 12.—Map showing distribution of the Dermatemydidæ.

Fig. 12 displays the distribution of the Dermatemydidæ. This is one of the decadent families of the order, for it abounded in genera and species in the Upper Cretaceous of North America and still existed in reduced numbers during the Tertiary. The family, now consisting of three genera and four species, is confined to portions of Mexico and Central America.

As seen from fig. 13, the Emydidæ have a wide distribution, occupying all the habitable portions of North America, South America, Europe, Asia, and most of the

East Indian islands. They are wholly missing from Australia and are conspicuously restricted in Africa. Only 2 species occur in the latter continent, and it is possible that one of these was introduced by man, since it inhabits also the south of Europe. Additional remarks on the distribution of the family will be found under the head of Emydidæ, on a subsequent page. Unless the genus *Gyremys* belongs really to the Emydidæ, the known members of the family appeared at about the same time

FIG. 13.—Map showing geographical distribution of the Emydidæ.

in America and Europe, in the Lower Eocene. It is remarkable that no members of the group were able to find their way into Africa with the Testudinidæ, for the latter were establisht there by the time of the Upper Eocene.

The Emydidæ that occur in South America are all, without doubt, descendants of those that entered that continent at a rather late period from North America. This was probably during the Pliocene. Only 4 species are known. Of these 1 belongs to *Trachemys*, represented by several species in North America, and 3 to *Nicoria*, a genus occurring also in eastern and southern Asia. *Nicoria*, however,

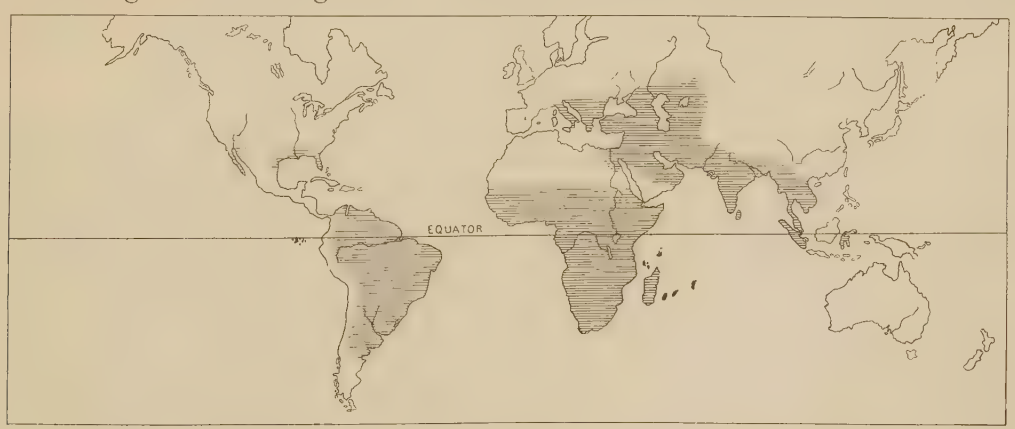


FIG. 14.—Map showing geographical distribution of the Testudinidæ.

does not appear to be greatly different from *Echmatemys* of the Bridger beds, yet distinct; and it is wholly probable that both Asia and South America received their stock from our own country. The distribution of these turtles resembles that of the tapirs. North America possesses at least 25 species of Emydidæ.

In fig. 14 we have a map representing the distribution of the Testudinidæ, at present, or at least within historic times. It will be observed that North America, which during the Tertiary was probably everywhere, except in the coldest parts,

inhabited by these land tortoises, presents only two very restricted areas. Tho at that time it abounded in representatives of the family, some of them of gigantic size, it is now poor in species, there being only 3. Almost the whole of South America is occupied by the family, but there are only 3 known species. Europe claims 2 species; while Asia possesses 7. Africa is the headquarters of the family, at least 20 species occurring on that continent. These belong to 3 recognized genera. The most remarkable feature of the distribution of the Testudinidæ is the occurrence of species, some of great size, on islands far away from any large body of land, as the Galapagos Islands and islands in the Indian Ocean. For further discussion of this subject the reader is referred to the treatment of the family on a succeeding page.

The geographical distribution of the Pleurodira is represented by fig. 15. It will be seen that the species are almost wholly residents of the torrid and the south temperate zones. A single species has an outlying colony on the Tropic of Cancer, at the head of the Red Sea. The wide distribution of these turtles is not surprising, seeing that they are a very ancient group. The earliest species that are known to belong to the superfamily are described in the present work and come from the Upper Cretaceous of New Jersey and New Mexico. Doubtless the group existed

FIG. 15.—Map showing the distribution of the Pleurodira.

during the Lower Cretaceous and probably during the Jurassic. In those early days the land masses had connections very different from those now obtaining; and these turtles were able to become diffused to regions now widely separated by deep seas from the original home of the creatures. It would appear more reasonable to suppose that South America had received its original pleurodiran population from North America, by the way of some Mesozoic land connection; but it is possible that these immigrants reacht that continent from Africa. A considerable number of authors, viewing the subject from different positions, have concluded that there was, during the Mesozoic era, a land connection between South America and Africa, which connection was interrupted about the beginning of the Tertiary. The existence of such a bridge would enable us to account for the occurrence of some closely related species in Madagascar and South America. These species are usually referred to the genus *Podocnemis;* but Baur regarded the Madagascar species as belonging to the closely related genus *Erymnochelys*. Two species of *Podocnemis* are reported from the Middle Eocene beds of the Fayum, Egypt.

Inasmuch as Pleurodires once occupied a large part of the north temperate zone, it is remarkable that they have not been able to maintain themselves there. The first and the last that are known to have lived in North America flourisht during

the Upper Cretaceous. In England species existed during the Eocene and a species of the same epoch has been described from India as a *Hydraspis*, a genus now existing in South America. It is worthy of note, too, that in North America the Pleurodires apparently disappeared long before the Amphichelydia did, the stock that gave origin to the Pleurodires. The Amphichelydia continued on into the Bridger and the Uinta.

It will be observed from the map (fig. 16) that the Trionychidæ occupy the habitable portion of North America east of the Rocky Mountains; Africa south of the Sahara Desert; Asia south of the Sayanskii and Yablonoi Mountains and between the Persian Gulf and the Caspian Sea; and most of the East Indian islands, including New Guinea. Altho the oldest-known representatives of the Trionychidæ have been found in the middle of the Upper Cretaceous of North America and altho that continent is still inhabited by at least 6 species, it is Asia that furnishes the greatest number of living forms of the family, at least 15 species having been described from that region, including the islands appertaining to it. In Africa there occur about 6 species, so far as now known. As in the case of the Cryptodires, the trionychids have prest southward close to Australia, without having succeeded in

FIG. 16.—Map showing the distribution of the Trionychidæ.

reaching it, *Pelochelys cantoris* having been reported from New Guinea. No Trionychidæ have been found in the Tertiary beds of the Fayum, Egypt. Considering the fact that true trionychids antedate known pleurodirids, it appears strange that the former were not able to reach Australia with the pleurodirids; more especially since the trionychids are, and have been since the Judith River epoch, excellent swimmers. A problem fully as hard to solve is the absence of trionychids from the continent of South America. So far as we can judge, they might easily, within rather recent geological times, have made their way thither from North America. Again, Ameghino has described what he regards as a species of *Trionyx* from the Cretaceous of Patagonia. The description is very brief and no figures have been furnisht. If representatives of the superfamily had reacht the continent by the time of the Upper Cretaceous it is remarkable that they were not able to maintain themselves there. No region appears to be better adapted than this for river-loving species of turtles.

In Europe we have another illustration of the fact that animals may be driven from a region in which they have once obtained foothold. No species of the superfamily now occupies that region; but numerous species did exist there during the Eocene, the Oligocene, and the Miocene. It has not yet been determined what the influences were that operated against them.

THE GEOLOGICAL DISTRIBUTION OF THE TURTLES.

In tables 1 and 2 the writer has endeavored to present in as accurate and effective a manner as possible the chronological distribution of the fossil turtles of North America, with the positions of the turtle-bearing beds and the level at which each species has been found. Table 1 represents the principal divisions and subdivisions of the Mesozoic age, except the Triassic, while table 2 deals in like manner with the Cenozoic. No small difficulty is experienct in the preparation of such tables. The limits of the larger formations and the periods which they represent have not received general acceptance; and when we come to consider the smaller divisions and the correlation of deposits in distant regions there are in many cases widely divergent views. Again, in the collection of the fossils there has often been too little care exercised in preserving records of localities and levels. An interrogation mark (?) preceding any generic name indicates that the species immediately succeeding possibly does not belong to the level indicated.

TABLE 1.—*Principal divisions of the Jurassic and Cretaceous, with the species of turtles known from each.*

Mesozoic.	Upper Cretaceous.	Denver.		? Glyptops depressus.	
		Arapahoe.		Adocus ? lineatus, Plastomenus ? punctulatus, P. insignis, Aspideretes vagans.	
		Laramie.		Baëna marshi, B. hatcheri, Eubaëna cephalica, E. latifrons, Thescelus insiliens, T. rapiens, ?Naiadochelys ingravata, Basilemys sinuosa, Compsemys victa, C.? obscura, Helopanoplia distincta, Aspideretes foveatus, A. beecheri, A. austerus, A. fontanus, A. vorax.	
		Fox Hills.		No turtles known.	
		Pierre.	Bear Paw.	No turtles known.	EASTERN REGION. (Greensand, etc., approximately equivalent to Pierre, etc.) Bothremys cooki, Taphrosphys sulcatus, T. longinuchus, T. leslianus, T. strenuus, T. molops, T. nodosus, T. dares, Amblypeza entellus, Osteopygis emarginatus, O. gibbi, O. robustus, O. chelydrinus, O. erosus, O. borealis, O. platylomus, O. sopitus, Catapleura repanda, C. ponderosa, Peritresius ornatus, Lytoloma angusta, L. jeanesi, L. wielandi, Erquelinnesia molaria, Rhetechelys platyops, ?Neptunochelys tuberosa, Atlantochelys mortoni, Adocus beatus, A. punctatus, A. lacer, A. syntheticus, A. agilis, A. pravus, Agomphus turgidus, A. petrosus, A. tardus, A. pectoralis, A. firmus, A. masculinus, Zygoramma striatula, Z. microglypha, Homorophus insuetus, Amyda ? prisca, A.? halophila.
			Judith River.	Baëna callosa, B. antiqua, Boremys pulchra, Neurankylus eximia, Charitemys captans, Polythorax missuriensis, Basilemys variolosa, B. imbricaria, ?Compsemys victa, Gyremys spectabilis, Plastomenus costatus, Aspideretes foveatus, A. coalescens, A. splendidus, A. beecheri.	
			Clagget.	Toxochelys latiremis ?, Porthochelys browni, Archelon ischyros, A. marshi.	
			Eagle.		
		Niobrara.		Toxochelys latiremis, T. serrifer, T. brachyrhina, T. stenopora, T. elkader, T. procax, T. bauri, Cynocercus incisus, Porthochelys laticeps, Protostega gigas, P. potens, P. advena.	
	Lower Cretaceous.	Benton.		Glyptops pervicax, Desmatochelys lowi.	
		Dakota.		No turtles known.	
		Washita.		Glyptops? belviderensis.	
		Fredericksburg.		No turtles known.	
		Trinity.		Glyptops cælatus (In Potomac beds).	
	Jurassic.	Morrison.		Glyptops plicatulus, Probaëna sculpta.	
		Unkpapa.		No turtles known.	
		Sundance.		No turtles known.	

TABLE 2.—*Principal divisions of the Cenozoic, with the names of the turtles found in each.*

Cenozoic.	Pleistocene.			Chelydra serpentina, Clemmys percrassa, C. insculpta, Chrysemys timida, Trachemys petrolei, T. bisornata, T. trulla, Terrapene marnochi, T. eurypygia, ?T. canaliculata, Testudo laticaudata, T. hexagonata, T. atascosæ.	
	Pliocene.	Peace Creek.		Macroclemys floridana, Deirochelys floridana, Trachemys sculpta, T. jarmani, T. euglypha, Pseudemys extincta, Terrapene putnami, Testudo crassiscutata, Platypeltis ferox?	
		Blanco.		Testudo turgida, T. pertenuis, T. campester, Clemmys hesperia (Rattlesnake beds).	
	Miocene.	Upper.	PLAINS AND MOUNTAIN REGION. Trachemys hilli, Testudo orthopygia, T. edæ, T. hollandi, T. impensa, T. niobrarensis, T. gilberti, T. undata, T. klettiana.	YORKTOWN EPOCH OF ATLANTIC REGION. Syllomus crispatus, Procolpochelys grandæva, Amyda? buiei, A.? lima, A.? cellulosa.	
		Middle.		Clemmys saxea, Testudo pansa, T. osborniana, T. farri.	
		Lower.		Testudo vaga, T. arenivaga, T. peragrans, T. inusitata, T. emiliæ.	
	Oligocene.	John Day.		Stylemys oregonensis, S. capax, S. conspecta, ?S. calaverensis.	
		Brulé.		Stylemys nebrascensis, Testudo thomsoni, T. laticunea, T. ligonia, T. amphithorax, T. quadrata, T. cultrata.	
		Chadron.		Xenochelys formosa, Graptemys inornata, Testudo brontops, T. exornata, Platypeltis leucopotamica.	
	Eocene.	Upper.	Uinta.	Baëna emiliæ, Echmatemys callopyge, E. uintensis, Hadrianus tumidus, Amyda crassa.	
		Middle.		D. ?Echmatemys septaria (Washakie), ?Amyda egregia (Washakie).	GULF REGION. Jackson epoch.
				C. Anosteira ornata, Amyda salebrosa, Platypeltis serialis, P. postera.	
			Bridger.	B. Baëna arenosa, ?B. clara, B. sima, B. riparia, Chisternon undatum, C. hebraicum, Baptemys wyomingensis, ?B. fluviatilis, Anosteira ornata, Clemmys morrisiæ, Echmatemys wyomingensis, E. haydeni, E. stevensoniana, ?E. septaria, E. arethusa, E. cyane, E. shaughnessiana, E. ocyrrhoë, E. ægle, E naomi, E. pusilla, E. latilabiata, ?E. polycypha, ?E. terrestris, Hadrianus corsoni, Achilemys allabiata, Plastomenus thomasi, P. visendus, P. tantillus, P. œdemius, P. molopinus, Aspideretes guttatus, A. ellipticus, A. grangeri, Amyda uintaensis, A. scutumantiquum, A.? concentrica, A. franciscæ, A.? exquisita, A. mira, A.? tritor, Temnotrionyx manducans, Platypeltis serialis, P. trionychoides, P. heteroglypta, P. extensa.	Hadrianus schucherti.
				A. Anosteira radulina, Hybemys arenaria, Amyda æqua.	
			Wind River.	Baptemys tricarinata.	
		Lower.		ROCKY MOUNTAIN REGION.	EASTERN REGION.
			Wasatch.	Baëna arenosa, Kallistira costilata, Notomorpha gravis, Echmatemys lativertebralis, E. cibollensis, E. megaulax, E. testudinea, E. euthneta, Hadrianus majusculus, Plastomenus catenatus, P. corrugatus, P. communis, P.? leptomitus, P.? lachrymalis, P.? fractus, Amyda cariosa, A. radula, Platypeltis serialis.	Lembonax polemicus, L. insularis, L. propylæus, Chelonia parvitecta, Agomphus oxysternum, Amyda? pennata, A.? virginiana.
			Torrejon.	Baëna escavada, Alamosemys substricta, Hoplochelys saliens, H. paludosa, Aspideretes singularis.	
			Puerco.	?Hoplochelys crassa, Conchochelys admirabilis, Aspideretes sagatus, A. puercencis, A.? nassau (Fort Union beds).	

In North America no turtles are known to have existed in deposits below the Morrison beds of the Upper Jurassic. Dr. Edward Hitchcock has indeed assigned to the tortoises certain tracks observed by him in the Triassic sandstones of Massachusetts and Connecticut; but, while there is no improbability that turtles occurred there and then, there is no certainty of it. As is seen from table 1, 2 species of turtles, both belonging to the Amphichelydia, have been found in the Morrison beds of the Rocky Mountain region. These beds are sometimes regarded as belonging to the Lower Cretaceous, equivalent to the Wealden of Europe, but it is more probable that they correspond to the Kimeridge Clay or the Purbeck (Fraas, Zeitschr. deutch. geol. Gesellsch., LIII, 1902, briefl. Mitth., p. 59) or even a little lower. So far as now known, no other group than the Amphichelydia are represented until we reach the Benton, of the Upper Cretaceous. In the lowest division of this there occurs an undoubted marine turtle belonging to the Cryptodira. A species of *Glyptops* is found in the Potomac beds near Washington, District of Columbia, and another species of probably the same genus in the Washita beds of Kansas.

Turtle remains are not uncommon in the Niobrara beds of Kansas, but when we come to examine the list, we find the species not numerous, and they belong to only four genera. The species of *Toxochelys* and of *Porthochelys* appear to have lived in the Niobrara ocean near the coasts. The species of *Protostega*, on the other hand, evidently ventured far out on the high seas. *Toxochelys* and *Porthochelys* appear to have continued on into the Pierre; *Protostega* was there replaced by, or transformed into, the huge *Archelon*.

About the middle of the Upper Cretaceous, conditions were favorable for the existence and the inhumation of many species of turtles. These are found now in two widely removed regions and in deposits made under widely different conditions. On the Atlantic border, especially in New Jersey, occurs a series of marine deposits from which have been derived about 40 species of turtles, including 9 species of Pleurodira and 2 species of Trionychidæ. The remainder are Cryptodira, among them many coast-inhabiting Thalassemydidæ, all of which were probably furnisht with jaws fitted for crushing hard mollusks and crustaceans. The family of Dermatemydidæ, represented now by only 3 genera and 4 species, appear in great numbers and variety, especially in the New Jersey Cretaceous greensand. Whence this assemblage of turtles came we have no clue. Scant remains indicate the existence of two species of large marine turtles, *Atlantochelys* and *Neptunochelys*.

In the heart of the continent at nearly the same time, possibly a little earlier, there were being laid down fresh and brackish water deposits, now known as the Judith River beds. They are found in Montana and British America, and have furnisht about 15 species of turtles; but these are quite different from those of the Atlantic coast deposits just mentioned. There are, indeed, 4 or 5 species of trionychids of the genus *Aspideretes*, a genus living now in Asia, a species of *Plastomenus*, and 3 or 4 species of Dermatemydidæ; but the latter belong to genera distinct from those found in the New Jersey deposits. In these Judith River beds reappear representatives of the Amphichelydia, turtles which we have found to characterize the Upper Jurassic and the Lower Cretaceous. In America the turtles of this group appear generally to have avoided true marine conditions.

Succeeding the Pierre and the Fox Hills epochs came that of the Laramie. In the fresh and brackish water deposits laid down during this time there were buried remains of a great variety of turtles, but unfortunately these remains are usually very fragmentary; 16 species are recognized as belonging here. Their relationships are close to the turtles of the Judith River beds, some species being as yet undistinguishable. The conditions under which the two deposits were laid down were so

similar that there is no wonder that the faunæ did not differ greatly. In the Laramie, as in the Judith River, there were Baënidæ and Trionychidæ. The Dermatemydidæ are represented by at least one species, *Basilemys sinuosa*, not greatly different from *B. variolosa* of the Judith River. The Pleurodira appear to be represented by one species, *Naiadochelys ingravata*, from New Mexico.

On entering the Tertiary there is no striking change in the turtle fauna. In the Fort Union, the Puerco, and the Torrejon, there are yet Trionychidæ, Dermatemydidæ, and Baënidæ. Representatives of the same families pass up into the Wasatch. Here, however, new elements enter, the Emydidæ and the Testudinidæ. It is not improbable that *Gyremys spectabilis* of the Judith River beds is an emyd, but the group is unmistakably represented in the Wasatch by *Echmatemys*, a genus in some respects highly specialized. The Testudinidæ are represented by the genus *Hadrianus*, the oldest-known genus of the family. All these Wasatch turtles inhabited either the land or the fresh waters of streams.

In the Atlantic region we have nearly contemporaneous deposits; and in them we find fragmentary remains of a few probably marine turtles and of Trionychidæ.

The Wind River beds have so far furnisht only a single species of *Baptemys*, and the humerus, 187 mm. long, of a trionychid.

The Bridger beds of Wyoming are exceedingly rich in turtle remains, as they are also in the bones of crocodiles and mammals. The Baënidæ were numerous in species and individuals. Only 2 genera of dermatemyds have been found. Emydidæ abounded, and Trionychidæ ran riot. In addition to these there were a few species of Plastomenidæ. All together, there are 50 or more species of turtles described from the Bridger Eocene. The abundance of Baënidæ and especially of the Trionychidæ shows that there were numerous streams and lagoons; and this conclusion is confirmed by the presence of many species of crocodiles. The occurrence of the great turtle *Hadrianus* seems to indicate the proximity of dry land.

Nearly all the species of Bridger turtles occur in the lower portion, that known as level B. No turtles have yet been described from the limestone bands, but fragmentary remains occur there. These bands appear to have been laid down in shallow lakes.

So far as known the turtles of the Uinta beds belong to genera found in the Bridger beds. No Plastomenidæ have been found, and the Baënidæ appear for the last time in our calendar.

During the Oligocene epoch the scene, for the student of turtles, shifts from the sea shore and the mountain regions to the Great Plains. In the lowest division, the Chadron or Titanotherium beds, are found 1 trionychid, 1 dermatemyd, and 1 emyd, silent witnesses of the presence of streams. On the other hand, there were numerous species of Testudinidæ, or dry-land tortoises, some of which attained a large size. Of *Stylemys nebrascensis* great numbers of shells have been found in South Dakota and Colorado, in the Brulé clays, or Oreodon beds. Species of *Testudo* were more abundant in the same deposits in Colorado. There can be no doubt that at this time the climate of the Plains region had become arid and the streams few. A similar climate appears to have prevailed in the John Day region of Oregon, where 2 or 3 species of *Stylemys* abounded, but, so far as known, no other turtles.

The Miocene deposits of the interior of the continent are characterized by the presence of species of *Testudo*, many of them of large size, resembling the gigantic tortoises of the Galapagos Islands. Sixteen species are described. In the Middle Miocene of Oregon there has been found a species of *Clemmys* (*C. saxea*); in the Upper Miocene of Kansas, *Trachemys hilli*. In the Yorktown beds of the Atlantic

Slope are found two species of the Cheloniidæ and fragments of three species of Trionychidæ. We can not doubt that in the streams of the Mississippi Valley and eastward there was an abundant population of water-loving turtles, but farther westward this order of reptiles was represented principally by the land tortoises.

During the Pliocene the land tortoises continued to predominate, especially in the interior region. Three species are known from the Blanco beds of Texas. In deposits of apparently the same age in Oregon there has been found a species of *Clemmys*.

In the Peace Creek beds of Florida, belonging apparently to the Upper Pliocene, there are found, with one large *Testudo*, numerous Emydidæ and a species of Chelydridæ. These are closely related to species yet living in that region. Among the numerous turtle bones put in the writer's hands from Hillsborough County, Florida, are many fragments that evidently belonged to yet undescribed species of Emydidæ and Trionychidæ.

In the scattered deposits of the Pleistocene, in which we might expect to find remains of turtles, we discover a few species; and these present a still closer approach to those now inhabiting the same territory. In what probably corresponds to the Equus, or Sheridan, beds of the region west of the Mississippi River have been discovered a species of *Chrysemys*, 3 species of *Trachemys*, a species of *Terrapene*, and 3 species of *Testudo*. It is worthy of note that no *Testudo* attains the size that was reacht by species of the genus during the Miocene and the whole of the Pliocene. In the Atlantic region, in caves and superficial deposits, have been found remains of the snapping-turtle, the sculptured turtle, another supposed species of *Clemmys*, and one or more species of box-tortoises.

Briefly let us consider the geological history of the turtles of other regions.

The earliest known turtle remains have been found in the Middle Triassic, the Muschelkalk, of Germany. Huene (Palæont. Abhandl., x, 1906) has described a few cervical vertebræ which he regarded as probably having belonged to cryptodiran turtles. In the Upper Triassic of the same country, the Keuper, has been found *Proganochelys*, a nearly complete shell of which has been described by E. Fraas (Jahresh. Ver. Naturk. Würrt., LV, 1899, p. 401). The present writer believes that this turtle belonged to the Amphichelydia, and it is probable that the cervical vertebræ from the Muschelkalk belonged to some turtle of the same group.

The next oldest known turtle, known only from impressions of the carapace on slabs of rock, is *Protochelys stricklandi*, from the Stonesfield slate, of the Great Oolite, of Oxfordshire, England. It belongs probably to the Amphichelydia.

In contrast to the scanty chelonian population of the North American Upper Jurassic, that of Europe was extremely numerous. From the Jurassic at Solothurn, Switzerland, about 15 species have been described. From deposits of approximately the same age in Germany, France, and England, numerous other species have been reported. Many of the species have come from the Kimeridge, of the upper portion of the Great Oolite, a formation found in England, France, and Germany, and belonging near the level of the Morrison beds of Wyoming, as already stated. The principal genera described from the Upper Jurassic of Europe are *Pleurosternon*, *Platychelys*, *Plesiochelys*, *Idiochelys*, *Hydropelta*, *Parachelys*, *Acichelys*, *Thalassemys*, *Stegochelys*, and *Tropodemys*. The first two belong without doubt to the Amphichelydia, *Pleurosternon* being closely related to *Glyptops* and *Platychelys* to *Probaëna*. *Craspedochelys* and *Plesiochelys* are almost certainly not Pleurodira and may be referred provisionally to the Amphichelydia. The other genera are to be referred to the Thalassemydidæ, a family of Cryptodira. Similar turtles are found a little higher up in the European Jurassic, in the Purbeck

and Portlandian; likewise, in the Wealden, of the Lower Cretaceous deposits of approximately the age of the Trinity and Potomac. In the Portlandian is found a species of *Pleurosternon*. In the Wealden occurs the genus *Tretosternon*, which may have given origin to the Dermatemydidæ.

In the Gault, at the base of the Upper Cretaceous of England, have been found remains of a large turtle which is called by Lydekker *Chelone jessoni* (Quart. Jour. Geol. Soc., XLV, 1889, p. 231). While it is possible that this species belonged to the Chelonidæ, it is improbable that it was congeneric with our living green-turtle. It would be more proper to call it *Cimochelys jessoni*.

The Cambridge Greensand, of the Cenomanian, near the time of the American Dakota or Benton, furnishes a number of turtles. These are represented by skulls alone and are placed in the genus *Rhinochelys*. Their affinities are uncertain, but they are neither Pleurodira nor Trionychoidea. The genus seems not to be represented in America.

In the Lower Chalk, Turonian, of Kent, England, are found remains which are assigned by Lydekker (Cat. Chelonians, 1889, p. 34) to *Chelone benstedi*. For the reason noted above, this species ought to be called *Cimochelys benstedi*, as it was named by Owen. The Turonian was deposited approximately at the time of our Niobrara beds.

In the Upper Cretaceous of England and the continent is found a huge marine turtle, *Allopleuron hoffmani;* its costals are greatly reduced. In Italy has been found another large sea-turtle, *Protosphargis*, reminding us of *Protostega* and *Archelon*, of the American Upper Cretaceous.

In the Upper Cretaceous of Provence, France, has been discovered the remarkable turtle, *Polysternon*. Besides mesoplastra it possesses a pair of bones between the hypoplastra and the xiphiplastra, and the pelvic bones are sutured to the xiphiplastra. It is regarded as a pleurodire; and it appeared about the time that this group presented itself in America.

During the Tertiary period the history of European turtles appears to have run on much as it did in America, altho in each country the history had its peculiar features. Osborn (Ann. N. Y. Acad. Sci., XIII, 1890, p. 7) finds that America and Europe had a similar mammalian fauna throughout the Lower Eocene, but that there followed a Middle and Upper Eocene interval of faunal separation of the two countries; while again there was an approach, from the beginning of the Oligocene onward until the late Pleistocene. With respect to the turtles it may be said that the two regions were farther apart at the beginning of the Eocene, converged to perhaps the middle of the Pliocene, then diverged.

In the London Clay of England is found *Eosphargis*, the earliest representative of the Athecæ. In Belgium at the same time there existed *Pseudotrionyx*, a relative of the living *Carettochelys*. In England there were yet two species of Pleurodires. So far as known, the group was not represented at the time in America. In Europe there were no Amphichelydia, no Dermatemydidæ, no known species of Plastomenidæ, and no Trionychidæ. The species of *Argillochelys* may belong to the Cheloniidæ. Species referred by Lydekker to *Chrysemys* represent the Wasatch Emydidæ, while *Homopus comptoni* represents *Hadrianus*.

The Middle Eocene of Europe witnest a great multiplication in the number of Trionychidæ. Species referred to the yet living Asiatic genus *Ocadia*, of the Emydidæ, resembled the Bridger genus *Echmatemys*. The Bridger epoch differs from the European Eocene in its numerous species of Baënidæ.

During the Oligocene, Europe possest numerous Trionychidæ. Doubtless in America, too, they existed in numbers, but they have mostly escaped preservation.

America at that time yet harbored Dermatemydidæ; while Europe gave asylum to Chelydridæ and to the peculiar genus *Ptychogaster*.

During the Miocene, land tortoises, Testudinidæ, abounded in both America and Europe, turtles especially characteristic of dry lands. Europe possest various genera of Emydidæ and species of *Chelydra*, a genus now found only in North America, but apparently a late immigrant thither.

There are evidences that during the Pliocene the turtle population of Europe diminisht in genera, species, and probably in individuals. Trionychidæ were still found in Italy, but are not known after this time in Europe.

An interesting region for the student of chelonians is found in India. Here numerous species of Trionychidæ, Emydidæ, and Testudinidæ have been exhumed from late Tertiary; but most of the forms appear to belong to existing genera.

From the Upper Eocene fluviomarine beds of the Fayum of Egypt we have recently secured a most interesting and instructive addition to our knowledge of the turtles of that time, Dr. C. W. Andrews having described 9 species from those beds. One of these is a species of *Psephophorus*, related to *Dermochelys*. Of *Testudo* there are 3 species, a shell of one of which had a length of 1500 mm. A portion of the skull of a supposed species of *Thalassochelys* is also described. Of *Podocnemis* there are 2 species. Besides these, a new genus of Pleurodira, *Stereogenys*, with remarkable characters, is made known to us.

We must not omit to mention that remarkable Pleurodiran turtle, *Miolania*, which was originally described from remains found in Pleistocene deposits on Lord Howe Island, east of Australia. A second species was afterward discovered in Queensland, Australia; and more recently Dr. A. S. Woodward has described a third species from northern Patagonia. Outside the remarkable structure of this turtle, it becomes interesting for the reason that its presence in the regions named appears to confirm the theory that there was once land connection between Australia and South America.

DESCRIPTION OF GROUPS AND SPECIES.

Order TESTUDINES Batsch. Turtles and Tortoises.

Reptiles with the body relatively short and broad. Quadrate bone immovably joined to the pterygoid, the prootic, and paroccipital; its outer surface excavated to form a tympanic cavity. Paroccipitals not consolidated with the exoccipital. Vomer single, if not missing. Pterygoids closing the palate by their inner borders. Teeth never present; the jaws always armed with a horny covering. Nasal opening single. Dorsal ribs each with a single head; at least the anterior ones intervertebrally attacht. A nuchal bone always present. Cervical vertebræ eight; dorsals ten. Epiplastra (clavicles) and at least six other bones present in the abdominal wall. No sternum or sternal ribs ever developt. Each half of the pelvis composed of three bones, all contributing to the acetabulum. Four limbs always present. Humerus with ectepicondylar passage.

This order of Reptilia is divided into two suborders, the ATHECÆ and the THECOPHORA.

Suborder ATHECÆ Cope.

Turtles which retain the primitive dermal armor, with at least traces of the subdermal expansions connected with the ribs.

Of this suborder there is no known representative from North American deposits, unless possibly certain dermal bones that have been found to accompany the remains of *Basilosaurus* (*Zeuglodon*) belonged to some otherwise unknown species of the group. This is improbable, however, as shown by Dames (Pal. Abhandl., v, 1894, p. 220). In Europe the suborder is represented by *Eosphargis*, of the London Clay of England, by *Psephophorus*, of the Oligocene and Miocene of the Continent, and perhaps by *Pseudosphargis*, of the Upper Oligocene of Germany. The latter genus is based on a very imperfect skull; and, while presenting many resemblances to *Dermochelys*, is not regarded by the present writer as being at all certainly a member of the Athecæ. This turtle possest descending plates from the parietals to the pterygoids.

Suborder THECOPHORA Dollo.

Turtles in which the primitive dermal armor has become obsolete or abolisht. Always a more or less complete carapace formed by at least the expansions of the ribs, the nuchal bone and with rare exceptions a series of neurals; usually a very complete shell formed by the bones mentioned, together with series of peripherals and a varying number of plastral bones. Skull always furnisht with descending parietal plates.

This suborder, containing the vast majority of turtles, living and extinct, consists of four superfamilies, the AMPHICHELYDIA, the PLEURODIRA, the CRYPTODIRA, and the TRIONYCHOIDEA. Of the first there are no living representatives.

KEY TO SUPERFAMILIES OF THECOPHORA.

1. Mesoplastra present or absent. If absent, hinder lobe of plastron with rough scars for union with pelvic bones except in Plesiochelyidæ.
   - a^1. Mesoplastra always, so far as known, present; no plastral scars ..... *Amphichelydia*
   - a^2. Mesolpastra present or absent; rough scars on hinder lobe of plastron ..... *Pleurodira*
2. Mesoplastra always absent; no sutural scars on plastron.
   - a^1. Peripheral bones always present ..... *Cryptodira*
   - a^2. Peripheral bones present only in one genus now existing ..... *Trionychoidea*

Superfamily AMPHICHELYDIA Lydekker.

Thecophorous turtles having a carapace composed of neural, costal, and peripheral bones and a plastron in which the epiplastra are in contact with the hyoplastra. Mesoplastra usually, perhaps always, present. Intergular and inframarginal scutes probably always developt.

Skull essentially cryptodiran in structure, but with various primitive elements. Neck short, the vertebræ little differentiated. Limbs, so far as known, fitted for walking.

This group was establisht by Mr. Richard Lydekker, to include, as he states, a number of generalized late Mesozoic forms which may be regarded as allied to the earlier (and then unknown) progenitors of the Pleurodira and Cryptodira. He characterized them as having a shell constructed on the plan of that of the Cryptodira and Pleurodira, in which mesoplastral bones and an intergular shield are developt. The pubis may articulate, without sutural union, with the xiphiplastron. At the time he wrote the skull and neck were not known. The coracoid and the humerus were regarded as being of the pleurodiran type. The genera included were *Pleurosternon*, *Baëna*, and *Platychelys*. (Lydekker, Cat. Foss. Rept. Brit. Mus., pt. III, 1889, p. 204.)

In 1890 (Amer. Naturalist, XXIV, p. 530) and 1891 (Proc. Acad. Nat. Sci. Phila., p. 411) Dr. George Baur, working on materials at Yale University, added greatly to the knowledge of the group, regarded by him as a suborder. He likewise furnisht a definition of the group. The present writer (Bull. Amer. Mus. Nat. Hist., XXI, 1905, p. 137), having studied well-preserved remains of *Baëna* from the Bridger beds, was enabled to make further additions to our knowledge of the Amphichelydia and to correct some of Dr. Baur's statements and generalizations.

In this superfamily the plastron appears to be in all cases more or less closely joined to the carapace by sutural union with the peripherals, and in the Baënidæ the union is strengthened by powerful axillary and inguinal buttresses. In all forms known to belong to the group there are well-developt mesoplastra; but since these bones have been abolisht from the plastron of all the Cryptodira and from that of most of the Pleurodira, there seems to be no good reason to suppose that they might not have been suppresst in the case of some of the Amphichelydia. Accordingly the writer has ventured (Bull. Amer. Mus. Nat. Hist., XXI, pp. 144, 167) to include provisionally in the superfamily the Plesiochelyidæ. Nothing is known certainly of the members of the family except the shells.

On the carapace of the Amphichelydia, besides the scutes found in such turtles as the Emydidæ, there may occur supernumerary vertebrals, costals, and supramarginals. On the plastron there are, in all known cases, intergulars and full series of inframarginals. The boundaries between the scutes are liable to vary in their positions. The sulcus between the paired scutes of the plastron especially is often found wandering far from the midline. It is as if the limits of the scutes had not in these early forms yet become firmly establisht. In the skull there are such primitive elements as distinct nasals and lacrimals. The temporal region is always covered over and the quadrates are notcht for the passage of the stapedial rod. The pterygoids never have the wing-like expansions that characterize the Pleurodira; and, unlike the latter, the pterygoids push themselves backward between the quadrates and the basioccipital and the basisphenoid.

The cervical vertebræ may, as in *Glyptops*, be all bicœlous, or, as in the Baënidæ, one end of most of them may be convex. The neck was short and the differentiation of the cervicals had progrest so little that probably these turtles could protect their heads neither by withdrawing them within the shells as do the Emydidæ, nor by laying them on one side beneath the front border of the carapace after the manner of the Pleurodira.

In the Pleurosternidæ and the Baënidæ, whose limbs are now known, these were fitted for progression on land. Doubtless they were inhabitants of the waters of lakes and rivers and were good swimmers, but there was no special modification of the limbs for swimming.

In addition to the families Pleurosternidæ and Baënidæ here treated, and the Plesiochelyidæ provisionally included, the writer refers to this superfamily without hesitation the Triassic genus *Proganochelys*, which has recently been so well described by Dr. E. Fraas. Without doubt this genus forms the type of a distinct family, the Proganochelyidæ, characterized by the broad shell, the hinder border of which is deeply scallopt, by the extremely broad vertebral scutes, by the series of supramarginal scutes in front of the first costals and behind the last ones, and by the mesoplastra, which meet at the midline and are enormously expanded at their outer ends. The genus *Proganochelys* is the oldest turtle of which we have any considerable knowledge, coming as it does from the Keuper, of the Trias. Cervical vertebræ of a genus named *Chelyzoon* have been described by Huene from the Muschelkalk of Germany. They have been supposed to belong to the Cryptodira, but there is little reason why they should not be referred to the Amphichelydia.

The most recent certainly known member of this subfamily comes to us from the Uinta beds of Utah. *Pleurosternon miocænum* Portis has been described from the Tertiary near Lausanne, Switzerland, but it is based on a badly damaged plastron.

1. Axillary and inguinal buttresses feebly develop. Plastron usually not notcht behind; mesoplastra usually not narrowed at midline ..... *Pleurosternidæ*
2. Axillary and inguinal buttresses strongly develop; mesoplastra narrowing toward midline.. *Baënidæ*

Family PLEUROSTERNIDÆ Cope.

A family of Amphichelydia. Carapace with costals articulated to the peripherals by close sutures and by gomphosis of ends of ribs. Plastron joined to the carapace by sutures and by narrow axillary and inguinal buttresses; the former ascending to the first costal, the latter attaining the borders of the fifth and sixth costals at their junction. In *Helochelys* the union of carapace and plastron probably less intimate. Mesoplastrals meeting broadly at the midline, not much expanded toward the outer ends. Exposed surfaces of carapace and plastron tuberculated or shagreened. Intergulars and inframarginals present. Skull elongated and pointed; the bones mostly finely tuberculated. The cervical vertebræ are biconcave. Coracoids distally expanded.

So far as the writer knows, the name Pleurosternidæ for this family was proposed by Prof. E. D. Cope in 1868 (Proc. Acad. Nat. Sci. Phila., p. 282) and was employed by him at various times afterward. He regarded it as a family distinct from the Baënidæ. Both families appear to have been always included by him among the Cryptodira. Lydekker (Cat. Foss. Reptilia, III, p. 205) includes in it the Baënidæ. Baur (Proc. Acad. Nat. Sci. Phila. 1891, p. 428) thinks it better to leave *Baëna* in a distinct family, nearly related to *Pleurosternon*. To the present writer each group appears to be worthy of family rank. The genus *Helochelys*, of the Cenomanian of Germany, evidently belongs with the Pleurosternidæ. *Pleurosternon* is found in the Purbeck and Portland Oolite of England. A species described by Roemer as *Emys menkei*, from the Wealden of Germany, is believed to belong to *Pleurosternon*. Portis has described *P. miocænum* from the Tertiary near Lausanne, Switzerland. In our own country, it appears that *Glyptops* existed from the Upper Jurassic through the Lower Cretaceous (*G. cælatus*) and the Benton (*G. pervicax*) into the Denver (*G. depressus*) of the uppermost Cretaceous.

Genus GLYPTOPS Marsh.

Carapace deprest. Exposed surfaces of the shell rough with small tubercles and twisted ridges. Neurals hexagonal, with the broad end in front. Costo-marginal sulci mostly below the costo-peripheral sutures. Axillary buttresses reaching border of first costals. Inguinal buttresses each entering an excavation at lower borders of fifth and sixth costals. Mesoplas-

trals joining extensively at the midline. Bridge about twice as broad as long. Inframarginals almost wholly on the plastral bones. Plastron with hinder lobe not shortened and not notcht behind. Pelvis not suturally articulated with the plastral bones. Skull pointed anteriorly; most of its surface bones finely tuberculated. Bones of lower jaw smooth; the symphysis short.

This genus was establisht by Professor Marsh in the year 1890 (Amer. Jour. Sci., XL, p. 177), his type being *G. ornatus*, collected in the Upper Jurassic of Wyoming. This species is apparently identical with Cope's *Compsemys plicatulus*. A comparison of specimens of *Compsemys victus* Leidy with Cope's species just mentioned makes it certain that the two forms are not congeneric. *Compsemys plicatulus* must therefore be removed from *Compsemys*, and Marsh's genus *Glyptops* becomes available. The assignment by Cope of various species of Jurassic and Cretaceous turtles to *Compsemys* was evidently due principally to supposed resemblances in the sculpture; but all of these species, except the type, *C. victa*, must be referred to other genera. There are no evidences that *C. victa* possest mesoplastra. The total absence of distal prolongations of the costals for insertion in the peripherals of *C. victa* and their presence in *G. plicatulus* sufficiently separate them generically.

To *Glyptops* is provisionally referred *G. pervicax*, which in some respects approaches more closely *Pleurosternon*, more especially in having the plastron slightly notcht behind. On the other hand, the bridge is longer than in *Glyptops plicatulus*. It is not improbable that it represents an undescribed genus.

It is to be noted that usually when authors have referred to the genus *Compsemys* they have had in mind the species *C. plicatulus*, because its characters were well known through Professor Marsh's and Dr. Baur's descriptions; whereas, little is even now known about *C. victa*. For these references the writer's Bibliography and Catalogue of the Fossil Vertebrata of North America, 1902, p. 437, may be consulted.

As here employed, *Glyptops* will include 4 species: the type, *G. plicatulus* of the Jurassic, *G. cælatus* of the Lower Cretaceous, *G. pervicax* of the Benton, and *G. depressus* of the uppermost Cretaceous. Possibly when more is known of the two last-mentioned species they will be removed from the genus.

Glyptops is closely related to *Pleurosternon* Owen, as already recognized by Dr. Baur. However, it differs from the latter in having the hinder lobe of the plastron less constricted and without posterior notch, in having the inframarginals almost wholly on the plastral bones, in having the costo-marginal sulci well below the costo-peripheral sutures, except over the bridges, and in having longer bridges. The distance from a line joining the free border of the anterior lobe of the plastron with the posterior lobe to the outer end of the mesoplastron is contained in the width of the bridge about three times in *Pleurosternon* and about two times in *Glyptops*.

Helochelys is another relative of *Glyptops*. Its hinder plastral lobe is little more than half as long as wide; the plastron appears to have been less closely joined to the carapace than in *Glyptops;* the bridges are short; and the last neural, the only one known, is hexagonal, with the broader end directed backward.

KEY TO THE KNOWN SPECIES.

A. Jurassic.
  a. Morrison beds ..... *plicatulus*
AA. Cretaceous.
  a. Lower Cretaceous.
    b. Potomac beds ..... *cælatus*
    bb. Benton beds ..... *pervicax*
  aa. Upper Cretaceous.
    c. Denver beds? ..... *depressus*

Glyptops plicatulus (Cope).

Plates 5, 6; text-figs. 17–27.

Compsemys plicatulus, Cope, Proc. Amer. Philos. Soc., xvii, 1877, p. 196.—Baur, Amer. Naturalist, xxiv, 1890, p. 534; Proc. Acad. Nat. Sci. Phila. 1891, p. 411; Anat. Anzeiger, xii, 1896, p. 565.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 437.

Glyptops ornatus, Marsh, Amer. Jour. Sci. (3), xl, 1890, p. 177, pl. vii, figs. 1, 2; Monogr. U. S. Geol. Surv., xxvii, 1897, p. 507, figs. 63, 64.

The present species is one of the two oldest known from North America, coming as it does from the uppermost Jurassic. The other species which comes from the same deposits is *Probaëna sculpta*, but it is represented by only an imperfect shell; whereas *Glyptops plicatulus* is represented by nearly all portions of the skeleton.

The species had for its type various fragments that had been collected for Professor Cope by Mr. O. W. Lucas, at Canyon City, Colorado, from freshwater deposits that were called by Professor Marsh the Atlantosaurus beds, by Scott and Knight the Como beds, and by Whitman Cross the Morrison beds. Cope's type is No. 6099 of the American Museum of Natural History. The principal parts present are one complete costal, apparently the third of the left side (plate 5, fig. 1), the proximal end of what is regarded as the fifth of the right side, the right axillary region, most of the left hypoplastron, and a part of the contiguous left xiphiplastron. The supposed third costal is shorter than the corresponding one of the American Museum specimen, No. 336, a slightly smaller individual, as shown by the hypoplastra. It might be regarded as the fifth were it not that the distal end is crost by the costo-marginal sulcus. The vertebral scutes are narrower than those of No. 336. Also the bases of the rib-heads are slenderer. The hypoplastral is somewhat longer and at the same time slightly narrower than that of No. 336. There is a possibility that we have here two species. The sculpture appears to be identical in the two specimens. Baur appears to have examined the type bones and he identified them as being the same as Marsh's *Glyptops ornatus*.

Professor Marsh's types of his *Glyptops ornatus* were obtained at Como, Wyoming, from deposits regarded as of the same age as those of Canyon City. The remains consisted of a skull nearly complete, portions of two other skulls, and portions of the shells of two or three other individuals. These were briefly described and figured by Marsh, as cited above. The figure of the skull particularly is very poor. This skull had been crusht laterally and hence the figure shows it as narrower than it was in life. A side view of the same skull, prepared for the U. S. Geological Survey, by F. Berger, is here presented (plate 5, fig. 2). In 1891 Dr. Baur, as cited, publisht a more extended description of Marsh's specimens and criticized some of Marsh's statements. The writer has examined the skull figured by Marsh. The occipital condyle is broken away. The length from the condyle to the tip of the snout was close to 62 mm. The temporal region was originally rooft over to a perpendicular plane passing through the articulations of the quadrate for the lower jaw. The extent of this roof from the orbits was 38 mm. The median suture may be traced from the tip of the snout to near the rear of the skull. Most of the other sutures are invisible. The supraoccipital spine appears to have been destroyed. The orbit is circular, with a diameter of 12 mm. The nasals are distinctly separated from the prefrontals and have a length of 4 mm. The premaxillæ are small and distinct from each other and from the maxillæ. What bone forms the septum between the orbit and the nasal cavity can not be determined. The maxilla has a thin cutting-edge and a narrow triturating surface. This bone extends far behind the orbit and has a length of 33 mm. From its hinder end the suture between it and the jugal may be traced upward and forward to the border of the orbit.

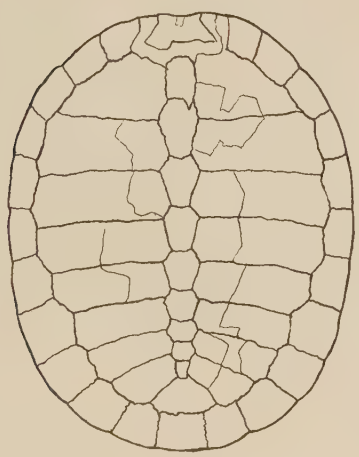
On the lower side of the skull is seen the anterior end of the vomer; the remainder is broken away. The choanæ were placed far forward. The palatines ran forward nearly to a line joining the fronts of the orbits. The pterygoids are interposed between the quadrates and the basioccipital. Where narrowest the pterygoid portion of the palate is 11 mm. wide. The articulation of the quadrate for the lower jaw is concave in all directions, most so from side to side.

In the American Museum of Natural History there is a specimen of this species that was collected at Bone Cabin quarry, Wyoming, about 10 miles from Como, the locality of Marsh's

specimens just mentioned. The number of the specimen is 336. It presents the shell complete, the dorsal and the cervical vertebræ, the skull quite complete, the shoulder and pelvic girdles, and portions of all the limbs. The skull will be described first.

When buried the skull was undoubtedly complete, but has suffered somewhat during disinterment and preparation (plate 5, figs. 3, 4). The bone is extremely brittle and much fractured. On this account, and because of the roughness of the surface, the sutures are mostly undeterminable. The length from the occipital condyle to the end of the snout is 66 mm., nearly the same as that of Marsh's specimen. In form it is wedge-shaped, but not so narrow as Marsh's laterally crusht specimen. The width at the quadrates is 48 mm. The supraoccipital spine is missing. It is doubtful whether it ever had any considerable length. The parietals lack about 5 mm. of extending backward as far as the occipital condyle. The roofing of the temporal region is like that of the skull just described. Whether or not the parietals join the squamosals can not be determined; they probably do. The orbits had a diameter of 15 mm., but some allowance must be made for distortion; they appear to have been larger than those of Marsh's type. The interorbital space measures 9 mm. Apparently the sutures bounding the frontals laterally can be distinguisht, and possibly those limiting these bones anteriorly. Nasal bones can not be distinguisht. The maxillary bone is only 3 mm. wide below the orbit. The tympanic cavity appears to have been small. The stapedial passage was open behind. The quadrates appear to have been directed slightly forward. The lateral squamosal processes extend behind the occipital condyle about 5 mm.

17.



18.

Fig. 17.—*Glyptops plicatulus*. Carapace. $\times\frac{1}{3}$. No. 336 A. M. N. H. Shows the various bones and many of the scutes.

Fig. 18.—*Glyptops plicatulus*. Carapace. $\times\frac{1}{3}$. No. 1357 Yale University. Shows only the bones. Figure from U. S. G. S.

On the upper surface there is observed on each side a groove, or sulcus, which starts about 8 mm. from the midline at the hinder border of the temporal roof, runs first forward and inward to near the midline, then toward the orbit. Similar sulci are seen in *Chelydra* and it is thus rendered probable that the surface of the head was covered with horny scutes.

The basioccipital and the basisphenoid are narrow. The suture between the two can not be certainly distinguisht. The basisphenoid can be traced forward about 30 mm. from the condyle. It is 7 mm. wide posteriorly and narrows anteriorly. It is doubtful if the pterygoids came in contact at any point. The pterygoid region, where narrowest, is 14 mm. wide. Toward the anterior end of the basisphenoid there is on each side, between this bone and the pterygoid, a foramen, such as is seen in *Baëna*, probably for the passage of a vein. In the skull here described a groove proceeds backward for some distance, and the appearance is such that the presence of a slit between the bones is suspected. The ectoptery-

goid processes are very large. The anterior region of the roof of the mouth is damaged, so that little is to be learned from it.

The lower jaw is closely prest against the remainder of the skull. From its tip to the hinder end is 54 mm. The two rami are co-ossified. The symphysis is 10 mm. long. All the bones are smooth.

Here it may be permitted to make some remarks on Baur's description of the skull of this species. The sculpture of the bones is not exactly like that of the shell, it being finer and more pustular. Baur, in opposition to Marsh, states that the exoccipitals take part in the formation of the condyles. It seems probable that Baur came to this conclusion from the presence of the pit, making the assumption that this is found only where the basioccipital meets the exoccipital. In the skull of a Bridger *Baëna* the basioccipital takes no part in the condyle, and yet there is a very distinct pit. The skull of *Glyptops* in the American Museum does not enable us to decide the question.

Portions of 7 of the cervicals are preserved in the American Museum specimen, the first not being present. As a whole, the neck seems to have been short and slender. Its total length did not exceed 120 mm., the carapace being 300 mm. The articular end of the second cervical has a diameter of only 4 mm., while that of *Trachemys elegans*, with a carapace 230 mm. long, has a diameter of 5 mm. All the cervicals present a deep, comprest, and sharp keel along the lower side, thickening behind. All, excepting probably the first, possest transverse processes, each about 4 mm. long. All have the anterior and posterior articular surfaces more or less concave. The hinder end of the eighth is concave, without the convex portion mentioned by Dr. Baur. The anterior end also is concave. The postzygapophyses are close together, but have not coalesct. The hinder end of the seventh is nearly flat, and we may suppose that it has entered on the first stages in forming a convex articulation. Barring the articular surfaces, these cervicals resemble closely those of *Baëna*.

The first dorsal vertebra has a very distinct keel along its lower side and the anterior end of the centrum is concave. The first rib is long, about 57 mm., and has apparently lost a portion of its extremity. It has a diameter of about 5 mm. and is applied closely to the rib of the first costal plate. The rib-heads are much like those of *Baëna*. The one belonging to the first costal plate is the broadest, about 12 mm. in diameter. Most of the others are smaller, about 8 mm. wide. The last two are considerably smaller. The tenth rib is short and thick, its length being 15 mm., its diameter 4 mm. Its outer end is somewhat enlarged, to support the ilium, and it is applied against the lower surface of the eighth costal. The first sacral rib is the larger, about 20 mm. long, and expanded at its outer end to a width of 10 mm. The second sacral rib is much slenderer. Both of them resemble corresponding parts of *Chelydra* and *Baëna*.

The carapace (plate 6; text-fig. 17) is 300 mm. long in the midline, and 272 mm. wide. It is much deprest, but this is due to some extent to distortion during burial, for some of the costals and peripherals are spread apart. Anteriorly the border is slightly excavated in the midline. Posteriorly the carapace is truncated and broadly and shallowly excavated. Marsh's figure represents his specimen as more rounded behind. The peripherals extended outward nearly horizontally. Their borders are subacute near the midline in front and behind, but they thicken and become more obtuse toward and over the bridges. The whole surface of the carapace and of the plastron is finely sculptured with tubercles and winding ridges, there being about 12 ridges in a line 10 mm. long.

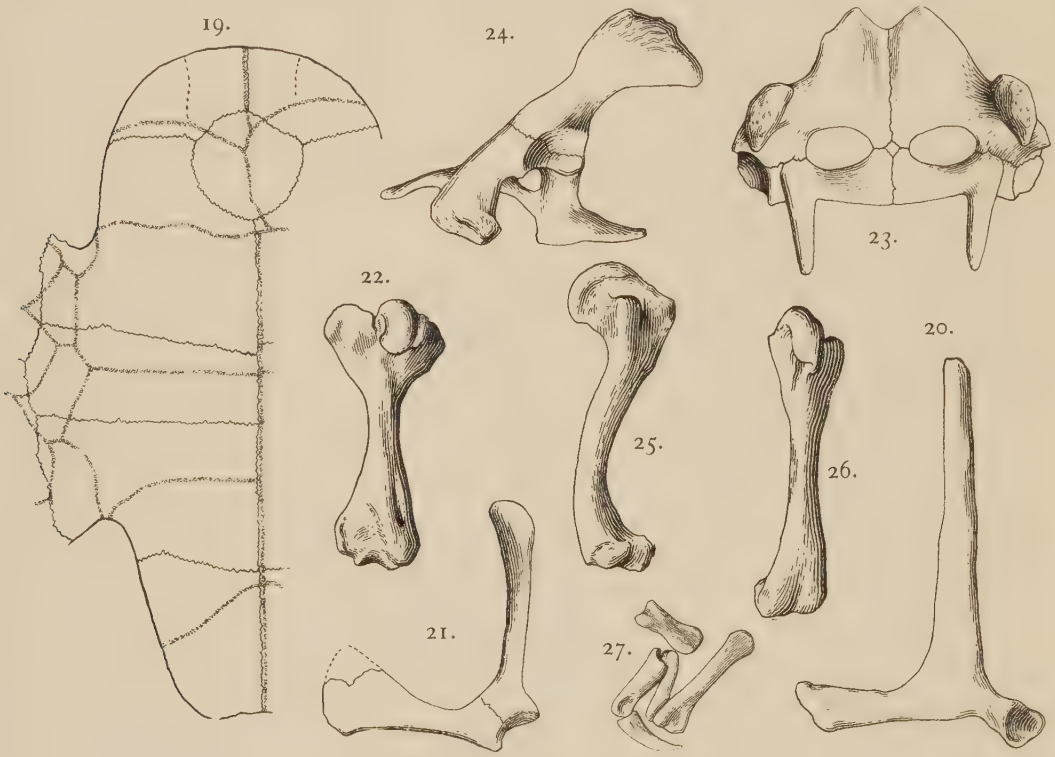
Neural.	Length.	Width.
1	38	23
2	30	26
3	32	24
4	26	23
5	27	23
6	19	19
7	18	20
8	18	21

The nuchal bone is quadrilateral, with the broadest side joining the first costals and the first neural. This side is 80 mm. long. The free border is 42 mm. long. The accompanying table presents the dimensions of the neurals.

There is in this specimen a single suprapygal. Baur states that in the Yale specimens there are two of these bones, but Marsh figures only one. A sketch in the writer's possession,

made apparently for Dr. Baur, and here reproduced (fig. 18), represents the first as small and occupying the space between the costals of the eighth pair. The suprapygal of No. 336 is large. Its length is 36 mm., its width anteriorly 14 mm.; the maximum 64 mm.; the posterior width 38 mm. This bone somewhat resembles in form that of a *Testudo*.

The costal plates narrow in succession backward. The peripherals are 11 in number on each side. Anteriorly and posteriorly they are high; over the bridges they are low. The first and second have a height of 35 mm.; the fifth, 18 mm.; the ninth, 40 mm.



Figs. 19–27. *Glyptops plicatulus*. No. 336 A. M. N. H.

19. Plastron. ×⅓. Shows bones and many of the scute areas.
20. Scapula. ×⅔. Procoracoid process, on the right, shortened by crushing.
21. Coracoid and procoracoid process of scapula. ×⅔.
22. Right humerus. ×⅔. Dorsal surface.
23. Pelvis from below. ×⅔. Somewhat crusht fore and aft.
24. Pelvis from left side. ×⅔.
25. Right femur. ×⅔. From tibial border.
26. Right femur. ×⅔. From dorsal surface; somewhat crusht.
27. Digital bones. ×1.

The plastron is flat (fig. 19). Its length is 260 mm. The anterior lobe is 80 mm. long; its width at the base, 122 mm. The edges are thick and rounded. The bones at the epihyoplastral suture are 8 mm. thick. The entoplastron is 43 mm. long and 47 mm. wide and broadly rounded behind. The hyoplastrals meet at the midline about 50 mm. The mesoplastra differ in width at the midline, the left being 30 mm. wide, the right 22 mm. The hinder lobe is 78 mm. long and 106 mm. wide at the base. The hinder border is truncated. The free borders are acute-edged. The bone thickens rapidly from the borders to about 10 mm.

The plastral bones are joined to the bridge peripherals by the usual rough sutures. Strong buttresses rise to the costals.

The sulci bounding the epidermal scutes are extremely obscure and in many places can not be determined. Where they can be observed they have been represented in the diagrammatic figures. Those of the plastron are less difficult of observation. The gular scutes are very broad, the sulci bounding them posteriorly curving outward and backward to near the epihyoplastral suture. The intergulars can not be made out on No. 336, but they are shown by Baur in a figure furnisht for him by the United States Geological Survey (plate 5, fig. 5).

These intergulars slightly overlap the entoplastron. The humero-pectoral sulcus passes behind the entoplastron. Dr. Baur's figure of the median sulcus represents it as running an exceedingly irregular course. In fig. 19 this sulcus is probably represented much too straight. On the bridges are very distinct inframarginals, as represented in fig. 19. Only the angles of these extend over on the peripheral bones.

Dr. Baur states that a nuchal scute is present in this species, but in No. 336 it can not be distinguisht with certainty. On most of the peripherals the sulci may be seen, both on the upper and the lower sides. The boundaries of the three anterior vertebrals have been determined quite satisfactorily. The width of these scutes is about 90 mm.

Dr. Baur has briefly described the shoulder-girdle. This is present in specimen No. 336 (figs. 20, 21) altho the distal portions of the coracoids are damaged so that their exact form can not be determined. The left half of the girdle is least injured and distorted. Here we find the scapula, the procoracoid process, and the coracoid standing at nearly right angles with one another. In this respect they are much as in *Chelydra*. The scapula is relatively shorter than in *Chelydra*, and the procoracoid is shorter still. The lower end of the scapula is strongly comprest. The glenoid fossa is removed outward some distance from the perpendicular portion of the scapula. This fossa presents some interesting peculiarities. It measures 7 mm. by 9 mm. and it has the long axis directed nearly horizontally. The fossa of *Chelydra*, nearly of the same shape, is directed nearly perpendicularly. Furthermore, there is, running along near the lower border of the fossa, a prominent ridge, which is found to correspond to a groove on the head of the humerus. Nothing of the kind is found in either *Chelydra* or *Testudo*, except in the most rudimentary form. However, in a specimen of *Trachemys rugosa* there are found similar structures; but here too, the long axis of the fossa is directed strongly upward. Examination of the naturally articulated parts of *Trachemys* shows that the motion of the humerus is nearly confined to a plane which is directed backward and downward. The motion of the humerus of a *Testudo*, with its round head, is much more free and varied. The *Testudo* is a tortoise adapted solely for walking; the *Trachemys* is to a great extent a swimmer.

Dr. Baur states that the fore limb of *Compsemys* (*Glyptops*) is long and resembles the elements of the Emydidæ. However, the humerus (fig. 22) is a little shorter proportionally than in *Trachemys rugosa* and the limb is rather feeble. The humerus is but little more than one-half as long proportionally as that of *Chelydra*. The bone is, however, not so slender as that of *Trachemys*, but has more of the form and proportions of *Chelydra*. This applies also to the size of the radial and ulnar tuberosities. The distal end of the humerus has points of interest. Its breadth is like that of *Chelydra*. There is distinct evidence of the presence of a deep coronoid depression. The ectepicondylar foramen pierces the bone at a distance of 11 mm. above the condyle. The trochlear surface reminds one of that of some mammal. Instead of forming an elongated smooth surface, convex in both directions, it presents two prominent ridges separated by a groove. The distal end of the humerus of *Trachemys rugosa* presents a somewhat similar structure, but the guiding ridges are far less prominent. As in *Glyptops*, the most prominent one is that for the head of the radius. The result of these arrangements must be that the motion of the forearm of both genera is confined to one plane, like that of the forearm of a man.

There is this difference, however, between the humeri of *Trachemys* and *Glyptops*. In the former these ridges run nearly parallel with a plane passing through the long axis of the head of the humerus. The effect of this is to make the forearm move in the same plane as the upper arm; that is, downward and backward. In *Glyptops*, on the other hand, the ridges of the trochlear surface are directed at an angle of about 45° with the plane of the head of the humerus. Hence, when the limb is drawn backward, the humerus moves in a horizontal plane, while the forearm, if flext, would move downward and backward.

One ulna is present. It is slightly longer proportionally to the humerus than it is in *Trachemys*, and its distal end is broader. Of the hand the writer can say nothing.

Baur has dealt with the pelvis without figuring it. He errs with regard to the inner ramus of the pubis, when he says it is a slender element and that the ischium is larger than the pubis. The contrary is true (figs. 23, 24). The pubis, aside from the lateral processes, does not differ greatly from that of *Chelydra* or *Testudo*. In the specimen before me it has an antero-posterior extent of at least 25 mm. It is quite deeply notcht in front. Baur is possibly, but not certainly

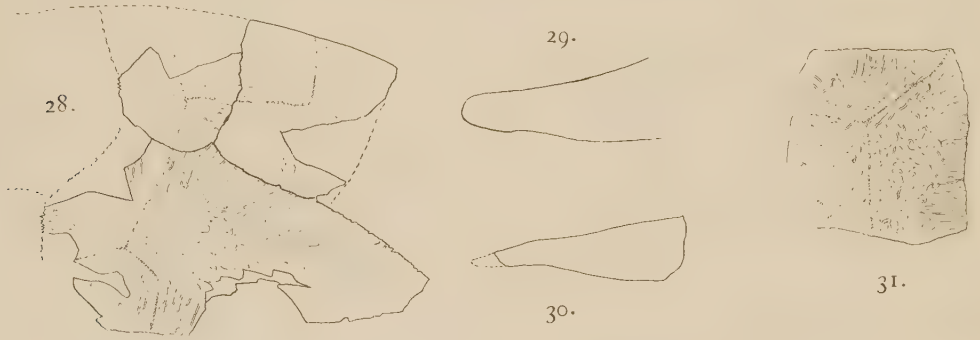
correct when he states that it did not come in contact in the midline with the ischium. The pelvis in the specimen here described has probably suffered some antero-posterior crushing, but the pubes and ilia do join. In *Baëna*, whose pelvis is identical with that of *Glyptops*, there is, at least in aged individuals, a union of these elements in the midline.

The lateral pubic processes are quite different from those of *Chelydra*, being more massive. At their extremities, where they come into contact with the xiphiplastra, they are enlarged and rough. Above this they are constricted into a sort of neck. The ischium is narrow from front to back, about 12 mm., and thin, as in *Baëna*. Its hinder lower border is nearly straight until the processes are reacht on which the ischium rests on the plastron. These processes stand at a distance of 30 mm. apart. Each is terete, pointed at its free end, and about 15 mm. long. They are directed backward.

The ilium is not greatly different from that of *Chelydra*, except that it is shorter and proportionately stouter. The sacrum is in general smaller and weaker than that of *Chelydra*, except that the distance of the acetabula apart is the same. The pelvis is essentially like that of *Baëna* and all parts should be compared with those of the latter genus.

The only portion of the hind limb present is the right femur and probably some foot bones. Dr. Baur states that the femur agrees with that of the Emydidæ. In length, it is exactly that of the *Trachemys* mentioned and relatively much shorter than that of *Chelydra*. It is much curved, especially toward the distal end (figs. 25, 26). The greater trochanter is separated from the lesser by a deep fossa. From the greater trochanter a prominent crest runs down on the hinder side of the femur one-third or more of its length. The distal end of the femur is damaged, but it presents indications of having had the condyles more prominently developt than in turtles in general. The total length of the femur in a straight line is 61 mm.

One complete toe, which probably belonged to a hind foot, is preserved with the parts in place (fig. 27). It shows a metatarsal and three phalanges, and these have a total length of 42 mm. The metatarsal is slender and has a length of 22 mm.



Figs. 28–31. *Glyptops cælatus*. Type specimen in U. S. N. M.

28. Portions of first and second peripherals and first costal. ×½.
29. Section across second peripheral. ×⅔.
30. Section across hinder peripheral.
31. Proximal end of costal bone, showing scute areas and sculpture. ×⅔.

Glyptops cælatus sp. nov.

Plate 7, figs. 1, 2; text-figs. 28–31.

The fragments of tortoise to which this name is given were collected by Mr. J. B. Hatcher, in 1887, at Muirkirk, Maryland, in deposits belonging to the Potomac formation of the Lower Cretaceous. The fragments consist of portions of costals and of peripherals. The most important fragment consists of the right first costal, a part of the first and most of the second peripherals. There is also a part of a costal situated further back in the carapace. These bear the number 1930, and belonged doubtless to one individual. There is present also a hinder peripheral and a first right peripheral which have the number 1939. There are also two fragments of costals of a young individual, one of which shows the rib-head. The bones bearing the number 1930 are regarded as being the type of this species. All the specimens are in the United States National Museum.

The first costal (plate 7, fig. 1; text-fig. 28) has a length, from its union with the neural to the pointed distal end, of 103 mm. and a width, fore and aft, of 50 mm. The thickness of the costal at the posterior border is about 5 mm. The anterior half of the bone is thickened to as much as 18 mm. to form a shoulder for the reception of the axillary buttress of the plastron. The latter must have been considerably more strongly developt than in *Glyptops plicatulus*. The head of the rib is stout. The first rib lies in front of and against the rib of the first costal plate. The first peripheral lacks its anterior half so that its antero-posterior extent can not be accurately determined. However, the missing portion is partly supplied by No. 1939. The anterior, or free, border is obtuse. At one end is the sutural surface for union with the nuchal bone. It appears quite unlikely that there was any considerable excavation in the front of the carapace for the neck of the animal. The first peripheral of No. 1930 was 30 mm. wide, parallel with the edge of the shell. The second peripheral has a fore-and-aft extent of 40 mm. and the width along the free border is the same. This border also is obtuse (fig. 29) and at a short distance from the edge the thickness is about 8 mm. It resembles very closely the corresponding one in *G. plicatulus*.

The posterior peripheral, probably the tenth of the right side, numbered 1939, is 39 mm. wide from the free border to the union with the costal, and 35 mm. along the free border. Its thickness, where it joined the costal, is 10 mm., and it has come down to an acute free edge (fig. 30). Its form is therefore that of a thin wedge.

The fragment of costal numbered 1930 (plate 7, fig. 2; text-fig. 31) shows neither the length nor the breadth. The piece is 35 mm. wide and has an epidermal sulcus running parallel with the sutural border and 27 mm. distant from it. The costal was therefore of considerable total width. Its thickness is only 5 mm. The true rib does not appear on the lower surface, as it does in *G. plicatulus*.

The sulci of this species are narrow and shallow, but quite distinct. Apparently the epidermal scutes resembled those of *G. plicatulus*, altho neither the vertebrals nor the marginals were so broad as in the latter species.

The sculpture of the surface is quite different from that of G. *plicatulus*. In the latter it has a more granular appearance and is produced by distinct raised dots and by short ridges formed of coalesct dots. In G. *cælatus* the dots are larger, the ridges also broader, longer, and smoother. The spaces between the elevations are as wide as the latter. In the centers of the bony surfaces the ridges are irregular in length and direction, and often vermiculate. Bordering the sutural edge is a broad band in which the ridges and grooves run at right angles with the suture. On the costals this band may be as much as 13 mm. wide.

Glyptops? belviderensis (Cragin).

Plate 7, figs. 4, 5.

Plesiochelys belviderensis, CRAGIN, Colorado Coll. Studies, v, 1894, p. 71, pl. ii, figs. 1–8.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 439.

The present writer has not seen the type specimens of this species. They belong to Colorado College, Colorado Springs, Colorado. They consist of two first costals, fragments of other costals, a neural bone and a dorsal vertebral centrum. These bones were found in the Kiowa shales, a portion of the Comanche series and near the top of the Lower Cretaceous. The locality is near Belvidere, Kiowa County, Kansas.

Dr. Cragin referred these bones to the genus *Plesiochelys*, but there appears to be no special reason for this assignment. The species of this genus, so far as certainly known, belong to the Jurassic, Kimeridge, and Wealden of Europe. The sculpture of the costals of Cragin's species suggests *Glyptops cælatus* and accordingly the species is referred with doubt to *Glyptops*. Two of Cragin's figures are here reproduced. Fig. 5, plate 7, represents a neural seen from the under side. It is relatively considerably broader than the neurals of *Plesiochelys* (Zittel's Handbuch Palæontologie, p. 545, fig. 502; Lydekker's Cat. Foss. Rept., pt. III, fig. 44). The front costals figured by Cragin are narrow, the width being 38 mm., the length 82 mm. The longest costal was 111 mm. long. The upper surface of the shell is said to be ornamented with delicate vermicular grooving and pitting. Fig. 4, plate 7, is intended to represent this sculpture of the costals.

Glyptops pervicax sp. nov.

Text-fig. 32.

The type of the present species is No. 1018 of the American Museum of Natural History. It was collected by Mr. Barnum Brown, in 1902, from near the base of the Graneros shales of the Benton deposits, in Yellowstone County, Montana. These shales are of marine origin. The locality more exactly described is on Brush Creek, 10 miles east of Pryor, in the county named. The remains consist of the front and the dorsal region of the carapace and the greater part of the plastron. The shell is that of an aged individual. Not a trace appears of the sutures, so that the structures can not be in all respects accurately determined.

The carapace had a length of about 375 mm. There was apparently a broad, low, rounded ridge running along the back in the areas of the second, third and fourth vertebral scutes. At the midline of the front, over the neck, there was a rounded excavation. The anterior free border was obtuse and about 10 mm. thick. The sulci are obscure, due mostly to an adhering incrustation of clay, but some of them can be traced. Portions of the second, third and fourth vertebral scutes may be mapt out. They were considerably broader than long. The third was 83 mm. long and had a maximum width of 130 mm.

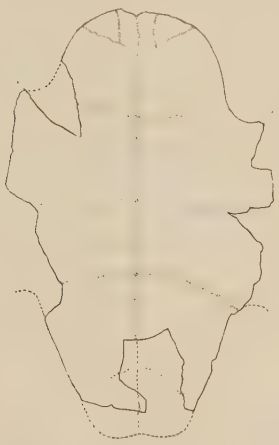


FIG. 32.—*Glyptops pervicax*. Plastron of type. $\times \frac{1}{6}$. Shows scute areas. No. 1018 A. M. N. H.

On the visceral surface of the carapace may be seen the bases of the rib-heads. These were not so strongly developt as in *G. plicatulus*. In the latter, as shown in No. 336, A. M. N. H., the rib-heads have a diameter of 10 mm., while in *G. pervicax* the diameter is about 7 mm. in a larger individual. The whole series is shown, on one side at least. The extremity of the tenth rib was co-ossified with the eighth costal about 10 mm. behind the rib-head of the costal named. On the first costal plate there is a prominent ridge which ran from the first and second vertebral centra to the border of the third peripheral and met the buttress of the plastron. At the peripheral this ridge has a width of about 18 mm. and a thickness of 11 mm. How high the buttress ascended can not be determined, for the suture is obliterated. It appears that the buttresses and the costal ridges meeting them were more strongly developt in this species than in *G. plicatulus*.

The total length of the plastron (fig. 32) was very close to 335 mm. The anterior lobe is broadly rounded in front, as it is in *G. plicatulus*. Its length is 85 mm., its width about 150 mm. The free border is obtuse. The bone is about 10 mm. thick. The limits of the entoplastron can not be determined. On the upper surface of this lobe, about 18 mm. behind the anterior border, there are two low processes, one on each side of the midline, which were probably for ligamentous attachment of the procoracoid processes of the scapula. In *G. plicatulus* the corresponding processes are about 34 mm. from the border.

The bridge has a width of 140 mm. Its inner end starts from a low ridge which runs from the free border of the anterior lobe to that of the posterior. The outer ends of the bridges are mostly missing.

The length of the posterior lobe was approximately 110 mm.; the width at the base, 142 mm. The free borders are acute on a level with the lower surface. From this edge the bone is beveled and rises to a thickness of 12 mm. Beyond this, toward the midline, the thickness diminishes again. At the hinder end of the lobe the thickness is only 5 mm. Most of the hinder extremity of the lobe is missing. A small fragment is present, but on account of some doubts it has not been used in the figure. On the upper surface of the lobe, very close to its border, there is a circular depression about 7 mm. in diameter, which received a process of the ischium. On the same surface about 60 mm. behind the inguinal notch, begins another depression, considerably larger, for the reception of the pubis.

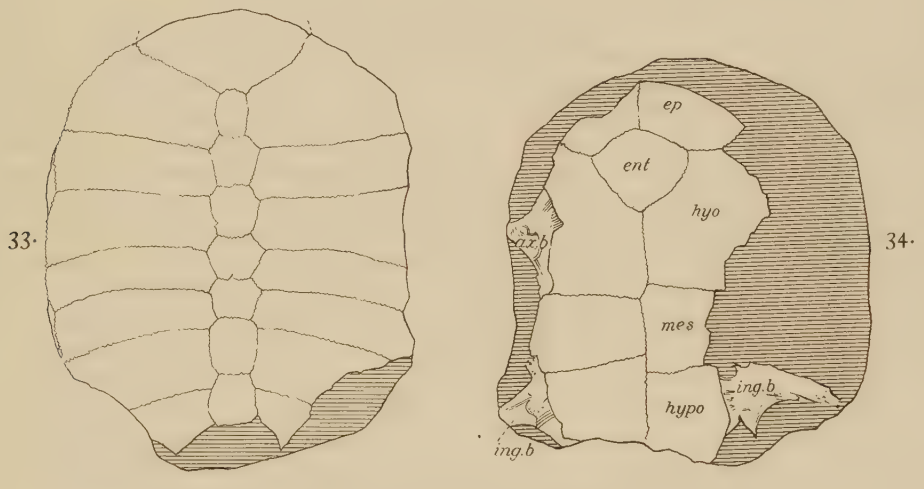
Most of the plastral scutal areas can be mapt out. The intergulars measured 32 mm. along the midline. Taken together, they had a width of about 28 mm. It can not be determined certainly whether or not they were divided at the midline. The gulars, as in *G. plicatulus*, had

been crowded out of contact with each other. The humerals measured 47 mm. at the midline; the pectorals, 63 mm.; the abdominals, 54 mm.; the femorals, about 78 mm. There were doubtless inframarginals on the bridges, but the sulci are obscure.

Since the preceding description was written a second specimen has been made available for study. This was collected by Mr. Barnum Brown, in 1904, in the Crow Reservation, Montana, at a point about 50 miles southeast from Billings and about 25 miles east of Pryor. The catalog number of the specimen in the American Museum is 6071. It furnishes more of the shell than does the type, but unfortunately the plastron is fractured and faulted obliquely to its length and the carapace is fractured and faulted in several directions.

The carapace was about 325 mm. long and the width is close to the same. The anterior border is preserved on each side to behind the axillary notches; it is obtuse and about 10 mm. thick. The surface presents the same kind of sculpture as the plastron, consisting of low winding ridges. The sulci are rather obscure, but the vertebral scutes were broad, as in the type, while the right third costal is seen to have been only 70 mm. high.

The length of the plastron appears to have been close to 295 mm. The bridge is 125 mm. wide. From the line joining the free borders of the anterior and posterior lobes of the plastron the bridge rose to the free border of the carapace, a distance of about 110 mm. The hinder lobe has a width of 125 mm. and a width of 110 mm. at its base. At the ends of the femoro-anal sulci the width is 83 mm. The hinder border confirms the accuracy of fig. 32. On the bridges are some indications of inframarginal scutes, too obscure to be traced.



Figs. 33 and 34. *Glyptops depressus.* Specimen in U. S. N. M.

33. Carapace of type. ×½.
34. Portion of plastron of type. ×½. *ax. b*, axillary buttress; *ent*, entroplastron; *epi*, epiplastron; *hyo*, hyoplastron; *hypo*, hypoplastron; *ing. b*, inguinal buttress; *mes*, mesoplastron.

Glyptops depressus sp. nov.

Text-figs. 33, 34.

The type of this species belongs to the United States National Museum. It appears to have been secured by one of Professor O. C. Marsh's collectors in 1889, inasmuch as it bears his packing number "1998. Box 3." With the specimen comes a statement by Mr. Whitman Cross, of the United States Geological Survey as follows:

"'No. 2 Box B. '89,' (Cannon's designation). An isolated fragment. (I think this fossil is from the Denver beds, from the nature of the sandstones between the shells and the apparently zeolitic material in cells of the bone.)"

Professor Marsh has recorded *Compsemys plicatula* from the Denver beds, but whether on the evidence of this specimen can not be determined. The probabilities that the same species is found from the top of the Jurassic to the top of the Cretaceous are remote.

The specimen presents considerable portions of the carapace and of the plastron. The

hinder end of the carapace has, at the time of burial, been crusht down to the plastron. After having been weathered out of the matrix the specimen suffered further damage, all that part behind the seventh neural having been destroyed. All the peripherals are likewise missing.

The length of the carapace (fig. 33) was originally about 120 mm.; the width was about 110 mm. The shell is deprest and was so probably during life. The surface of the carapace presents indistinct evidences of having been sculptured finely as in *G. plicatulus*, or possibly more like *Compsemys victa*. The anterior border of the nuchal bone is eroded away. The width of the bone was close to 38 mm. Its form is quite different from that of *G. plicatulus*. In the latter the postero-lateral borders are nearly parallel with each other, while in the present species they make nearly a right angle. The accompanying table presents the dimensions of the neurals present.

The great relative width of these neurals as compared with those of *G. plicatulus* is striking.

Neural.	Length.	Width.
1	12	9
2	13	13
3	12	14
4	11	14
5	10	12.5
6	15	14
7	14±	15±

The proximal end of the first costal is 14 mm. wide, while the width at the middle of the length is 26 mm. In *G. plicatulus* the median width is little more than the proximal. The succeeding costals, at the middle of the length, measure as follows: The second, 14 mm., the third, 14 mm., the fourth, 12 mm., the fifth, 11.5 mm., the sixth, 19 mm. The third expands distally to nearly 20 mm. The width of the sixth is relatively much greater than that of *G. plicatulus*, but it corresponds to the increased length of the sixth neural.

The anterior lobe of the plastron appears to have been rounded like that of *G. plicatulus*. The epiplastra are badly eroded, but the width of each is 13 mm. The entoplastron is 22 mm. long and 26 mm. wide. The antero-lateral borders come together to form an obtuse angle; the hinder end of the bone is more pointed. The mesoplastra are relatively broader fore and aft than those of *G. plicatulus*. That of the right side is about 15 mm. wide at the midline; but it expands laterally, so that at the middle of its length the width is 24 mm. That of the left side is 23 mm. wide at the midline, but narrows laterally for a short distance. The remainder is missing. It is remarkable how close the hinder border of the mesoplastron comes to the inguinal buttress, differing in this respect much from *G. plicatulus*.

There are evidences of rather strong axillary and inguinal buttresses. They appear to have articulated with the distal ends of the fifth and sixth costals, at their junctions.

On account of the weathering to which this shell has been exposed, the boundaries of the scutes can not be determined.

Family BAËNIDÆ Cope.

Amphichelydia having the plastron firmly joined to the carapace by sutural union with the lateral peripherals and with the costals by strongly developt axillary and inguinal buttresses. Mesoplastra usually meeting at the midline and expanding toward the outer ends. Skulls, so far as known, broad and short. Temporal roof extensive. Neck short, most of the vertebral centra with only one end concave.

To this family are assigned provisionally the genera *Polythorax* Cope and *Archæochelys* Lydekker. The former possest intergular and interhumeral scutes; the latter genus appears to have had a complete series of median plastral scutes.

The *Baënidæ* are closely related to the *Pleurosternidæ*, but the great advances made in the structure of the cervical vertebræ and the extension of the plastral buttresses seem to set the species off as a distinct family.

According to our present knowledge this family had an existence extending from the Upper Jurassic to the Upper Eocene. *Probaëna*, a close relative of *Platychelys*, of the Upper Jurassic of Europe, has been described from the Como, or Morrison beds, occurring there with *Glyptops*. Species belonging to *Baëna* are now known from the Judith River beds, the Laramie, and from all the divisions of the Eocene to the Uinta. *Boremys* Lambe comes from the Judith River deposits, *Eubaëna* from the Laramie, and *Chisternon* from the Bridger.

Baëna appears to be the genus most prolific of species and in most respects the one most advanct. The carapace possesses a series of 8 neurals and a corresponding number of costals,

a nuchal, 12 pairs of peripherals, and what must be regarded as a suprapygal, but no true pygal. The plastron has, besides the bones found in the Emydidæ, a pair of mesoplastrals, which usually reacht the midline and expanded greatly outward to join the fifth and sixth peripherals. The axillary and inguinal buttresses are high and wide. Between the axillary and the inguinal of each side there is a large sternal chamber. The axillary buttress ascended to a point a little above the lower border of the first costal, meeting there the comprest rib of the first dorsal vertebra. The inguinal buttress rose above the lower border of the fifth and sixth costals and was articulated in a ridge rising from the adjacent borders of these costals.

The scutes of certain regions of the shell are extremely variable; in other regions they vary little. On the carapace it is the area occupied in the Emydidæ by the first vertebral, the nuchal, and the first pair of costals that is subject to variation in its scutes. There may be on each side a supernumerary first costal scute, or it may occur on only one side, or it may be wholly absent. In some specimens is a second pair of supernumerary costals, lying just behind the nuchals. There may even be a supernumerary vertebral cut off from the front of the normal first vertebral.

On the plastron the gulars and intergulars are variable in form and size. The inframarginals vary in number and size and form. There are usually 4, but often the second from the axillary notch is missing on one or both sides. In this case the pectoral scute may or may not reach the marginals.

In *Chisternon* there intervenes between the nuchal bone and the first neural a large bone that is not present in *Baëna* (fig. 76). This the writer calls the preneural. In this genus too the occasional variations in the scutes of the front of the carapace appear to be quite the rule. The normal first vertebral scute is transversely divided, so that there are 6 vertebrals. There is usually on each side a supernumerary costal and sometimes two of them, making 6 pairs of these. The same variations occur in the scutes of the plastron of this genus that we find in *Baëna*. In one case there are 5 inframarginals.

It would be worth much to know the meaning of these variations in the bones and scutes. Is the presence of the preneural in *Chisternon* a primitive or a secondary condition? The writer does not regard it as probable that a bone like the nuchal has become secondarily divided, or that a new bone has become developt in that region. It appears more probable that both it and the nuchal are continuations forward of the row of neural bones, and that in the most advanct turtles the preneural has been crowded out of existence by the growth of the nuchal. It is evidence in favor of this view that in *Boremys* Lambe there is present a small preneural; also that it is present in the trionychoid genera *Aspideretes* and *Plastomenus*. These genera have probably inherited this bone from their Amphichelydian ancestors.

As regards the supernumerary scutes, we have the same questions to answer as in the case of the prenuchal. Do we have here a breaking up of the normal scutes into smaller areas, as has been observed in some modern genera by H. Gadow, W. P. Hay, and R. E. Coker; or do we have the normal number of scutes that were present in the earlier turtles, together with a tendency to a suppression of some of them? We must recognize the fact that on most parts of the shell the scutes are as stable as in ordinary turtles; altho, especially on the plastron, there is a tendency for the sulci to wander somewhat wildly. It is to be noted that the variations occur in those regions where, in modern turtles, certain scutes have been supprest. There can be no doubt that intergulars were primitively a possession of all turtles, but in most Cryptodira they have been supprest. The primitive turtles likewise possest on each bridge a complete row of inframarginals; but in most living genera these have been eliminated, with usually the exception of an axillary and an inguinal scute. There is probably not so much evidence that one or more anterior costal scutes have been supprest. In H. von Meyer's representation of *Acichelys crassipes* (his *Palæomedusa testa*, Lithogr. Schiefer, pl. xx, fig. 1) there is shown a pair of supernumerary costal scutes. It is also interesting to observe in that specimen 2 neurals between the first pair of costal bones. The anterior of these is probably the preneural. In the modern genus *Caretta* there are 5 pairs of costal scutes. It appears probable that the preneural and the supernumerary anterior vertebral scute tended to disappear together.

The skull of the *Baënidæ* presents various primitive features. The presence of distinct nasals, of lacrimals, and a wide temporal roof is to be cited. The writer has not found epipterygoids. The short supraoccipital is likewise primitive. When we leave aside these

characters the skull appears to be cryptodiran in structure. The neck must be regarded as primitive and intermediate between the Cryptodira and the Pleurodira. No features strictly pleurodiran appear.

The cervical vertebræ are described under the species *Baëna riparia* and *Chisternon hebraicum*. Considering the shortness of the neck, the structure of the vertebræ, and the narrowness of the anterior border of the carapace, it seems probable that these turtles were able to find in the shell little protection for their heads.

The tail was long, resembling that of *Chelydra*. With two or three of the skeletons there have been found some conical bones, the bases of which were buried in the skin. Some of these are symmetrical and it appears probable that they were placed in a row on the upper midline of the tail, as in *Chelydra*. Others of these bones are unsymmetrical, and possibly formed parts of lateral rows on the tail. If there had been an armor of dermal bones on the legs it would probably have been observed in some of the specimens.

For the shoulder-girdle and the pelvis the reader is referred to succeeding descriptions of *Baëna* and *Chisternon*. The limbs are of the walking type.

The following key may be of some use in determining the genera of the family:

A. No interhumeral scute.
  a. A preneural present.
    b. No supramarginal scutes ..... *Chisternon*
    bb. Supramarginals present ..... *Boremys*
  aa. No preneural so far as known.
    c. Plastron projecting little, if at all, beyond front of carapace.
      d. Skull with choanæ well in front ..... *Baëna*
      dd. Skull with choanæ between orbits ..... *Eubaëna*
      ddd. Skull unknown. Plastron with median fontanel ..... *Probaëna*
    cc. Front of plastron projecting in front of the excavated carapace.
      e. The axillary and inguinal buttresses not greatly develop ..... *Thescelus*
      ee. Axillary buttresses rising high on first costals ..... *Charitemys*
  aaa. Characters not well known. A suprapygal present; the vertebral scutes broad; 9 pairs of costals in type ..... *Neurankylus*
AA. Plastron with an interhumeral scute.
  a. Outer surface of plastron rugose ..... *Polythorax*
  aa. Outer surface of plastron with globular elevations ..... *Naomichelys*

Genus PROBAËNA Hay.

A genus closely related to *Baëna*, but with a more deprest carapace, the hinder border of which is little or not at all notcht. Vertebral scutes broader than the costal scutes. Plastron with its hinder lobe rounded. A fontanel (permanent?) between inner ends of mesoplastra.

It is not improbable that when the skull and the cervical vertebræ of this genus shall be discovered, it will prove that it belongs to the Pleurosternidæ and that the Baënidæ had not yet diverged from the former family.

Probaëna sculpta Hay.

Plate 7, fig. 5.

Probaëna sculpta, Hay, Ann. Carnegie Museum, II, 1903, p. 201, plate iii, figs. 1, 2.

The type is a small and somewhat imperfect turtle, represented by about three-fourths of the carapace and the greater portion of the plastron.

It belongs to the Carnegie Museum, Pittsburg, and was collected by Prof. J. B. Hatcher, in 1901, in the "Marsh quarry" in the lower portion of the Morrison, or Atlantosaurus beds, 8 miles north of Canyon City, Colorado. The catalog number is 917.

The length of the carapace is at present 105 mm., very near the original length; the width is 70 mm. The shell has apparently been rather flat, but probably somewhat less so in life than at present. The greatest distance between the upper and the lower surfaces is now 27 mm. The borders of the carapace behind the inguinal notches are considerably flared upward, but this may be due somewhat to post-mortem distortion. This border appears to have been

little or not at all notcht, except in the midline behind, where there is a slight excavation. In the nearly smooth hinder border this genus differs from the species of *Baëna*.

Most of the sutures and of the epidermal sulci are obscure; and in most parts of the carapace the sutures are incapable of determination. The sulci bounding the second, third, and fourth vertebral scutes are satisfactorily seen. These scutes were very broad, each about 34 mm.; while the costal scutes were only about half as wide. The areas occupied by the median scutes are conspicuously sculptured. The sculpture, as shown by the third scutal area, consists of ten or twelve prominent, sharp, uneven ridges, which radiate forward and outward from the middle of the hinder border of the area. Evidently a somewhat similar, but less bold, sculpture characterized the areas of the costal scutes; but these surfaces have been injured so that it can not be described. There is no evidence of the presence of supramarginal scutes.

On the left side the costal and marginal plates are broken away. The anterior and posterior buttresses of the plastron are thus revealed; and it is evident that the anterior one, joining the second costal plate, projected inward a considerable distance, as in *Baëna*, to form the anterior boundary of a lateral chamber, whose posterior boundary was formed by the hinder buttress joining probably the sixth costal plate.

When the costal plates broke away, the extremities of the third, fourth, and fifth ribs were left adhering in the matrix. These evidently past downward deeply against the inner sides of the corresponding marginal plates, as in *Chelydra*. Such was probably not the condition in *Baëna*. The ends of the ribs are terete, not flat as in most other cases. So far as can be determined, there were no fontanels between the costal plates and the marginals.

Of the plastron (plate 7, fig. 5) all is present except the epiplastrals, and possibly the anterior part of the entoplastron. The plastron resembles closely that of *Baëna;* but the hinder lobe is not notcht posteriorly, but rounded. There is a considerable fontanel between the inner ends of the mesoplastra. This may be due to the immaturity of the specimen; but judging from the closeness of all the sutures of our specimen, and from the fact that in *Baëna* the bones soon co-ossify, it seems probable that the fontanel would persist till a late period of life.

The anterior as well as the posterior lobe has a width at the base of 36 mm. The posterior has a length of 30 mm., and the anterior was probably about as long. The posterior lobe diminishes in width rather rapidly backward. The entoplastron was unusually long and narrow in its hinder portion. Nothing can be determined regarding the intergular and gular scutes. The mesoplastron is narrowed at the inner end, as in some species of *Baëna*. Each is traverst by the pectoro-abdominal sulcus.

The bridge is 30 mm. wide, fore and aft. The inframarginal scutes which covered the bridge can not be mapt with certainty, but there can be little doubt that they were present and much like those of *Baëna*.

P. sculpta may be regarded as a form ancestral to the later numerous species of *Baëna* which have been found in Belly River, Upper Laramie, Puerco, Bridger and Uinta beds. Dr. Baur regarded *Glyptops plicatulus* as the forerunner of *Baëna* (Proc. Acad. Nat. Sci. Phila. 1891, p. 421); but we now find in the same quarry from which *G. plicatulus* has been reported a form much nearer to *Baëna* than is *Glyptops*. It becomes evident that we must go back much further to find the common ancestor of *Glyptops* and *Probaëna*.

Platychelys, of the Upper Jurassic of Solothurn, Switzerland, is closely related to *Baëna* and *Probaëna*, and has been assigned by Lydekker to the Pleurosternidæ. It differs in having a more highly sculptured carapace, supramarginal scutes, and mesoplastrals which do not reach to the midline.

Genus BAËNA Leidy.

Shell firmly joined to the carapace by sutural union with the lateral peripherals and by broad and high axillary and inguinal buttresses. Hinder border of the carapace scallopt, and with an extensive excavation over the tail. Nuchal bone in contact with the first neural; no preneural; no supramarginal scutes; anterior lobe of plastron not extended in front of the carapace. Mesoplastra large, with the outer ends expanded. Posterior plastral lobe slightly emarginated. Intergulars, gulars, and inframarginals present. Skull broad, with the temporal region extensively rooft, the squamosals in contact with the parietals. Jugal forming a part of

the rim of the orbit. Triturating surface of the maxilla furnisht with a prominent longitudinal ridge. Choanæ opening on a line joining the fronts of the orbits.

KEY TO SPECIES OF BAËNA.

A^1. Judith River species.
1. Length of anterior lobe 0.60, its width 0.82, of width of bridge; width of hinder lobe 0.94 of width of bridge; entoplastron longer than broad ..... *callosa*
2. Plastron known only from part of anterior lobe; the entoplastron broader than long .. *antiqua*

A^2. Laramie species.
1. Length of anterior lobe 0.92, its width 1.00, of width of bridge; width of hinder lobe 1.04 of width of bridge ..... *hatcheri*
2. Length of anterior lobe 0.58, its length 0.79, of width of bridge; width hinder lobe 0.75 of width of bridge ..... *marshi*

A^3. Torrejon species ..... *escavada*

A^4. Bridger species.
1. Shell broad behind and deeply scallopt; strongly sculptured on back ..... *arenosa*
2. Not so strongly sculptured; a broad groove along the back ..... *riparia*
3. Shell oval, thin; the sculpture broken up into wrinkles; no median groove ..... *sima*
4. Shell oval; rounded behind; nearly smooth ..... *clara*

A^5. Unita species ..... *emiliæ*

Baëna callosa Hay.

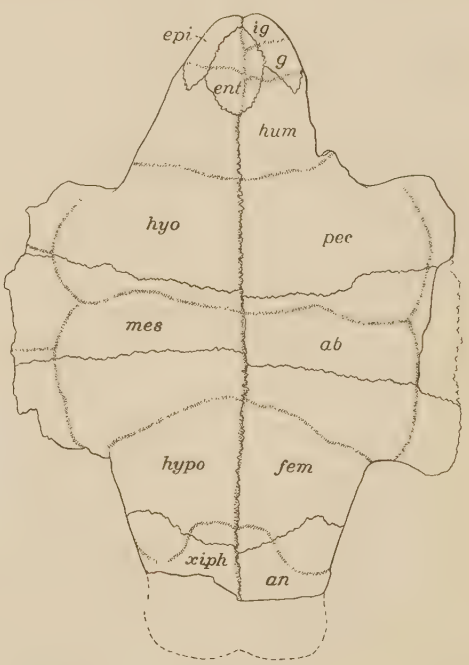
Plate 8, fig. 1; text-figs. 35, 36.

Baëna callosa, HAY, Ann. Carnegie Museum, III, 1904, p. 178, plate ix, text-figs. 1, 2.

This species is based on an incomplete shell which belongs to the Carnegie Museum, in Pittsburg, Pennsylvania. The number is 330. It was collected in the year 1903, by Mr. J. B. Hatcher, in the Judith River beds of Willow Creek, Gallatin County, Montana.

The posterior fourth of the carapace is missing; and of the anterior three-fourths, many of the peripherals and portions of the costals are wanting (text-fig. 35). The entire length of the

35



36

Figs. 35 and 36. *Baëna callosa*. Type. $\times\frac{2}{3}$.

35. Carapace. *c. s.* 1, *c. s.* 2, etc., costal scutes; *v. s.* 1, *v. s.* 2, etc., vertebral scutes.
36. Plastron. *ab*, abdominal scute; *an*, anal scute; *ent*, entoplastron; *epi*, epiplastron; *fem*, femoral scute; *g*, gular scute; *hum*, humeral scute; *hyo*, hyoplastron; *hypo*, hypoplastron; *ig*, intergular scute; *mes*, mesoplastron; *pec*, pectoral scute; *xiph*, xiphiplastron.

shell was about 250 mm.; the width something over 200 mm. The sutures between the various bones are not obliterated, but the preservation is such that they can not be satisfactorily traced. Most of the anterior border of the nuchal is broken away. The thickness at the free border is 6 mm.; and this border was rounded in section. The third costal is much thickened for the reception of the axillary buttress of the plastron, and the fifth and sixth were similarly thickened for the inguinal buttress. The second costal, near its proximal end, is 5 mm. thick.

The surface of the carapace presents evidences of a low ridge along the midline. On the area of the first costal scute there is a low elongated boss; and just in front of it, near the border of the shell, is a smaller one. In a complete shell there would probably be found a lateral carina on each side.

The first vertebral scute is small, having probably a length of less than 30 mm. and a width of 60 mm. The second is 48 mm. long and 65 mm. wide; the third, 57 mm. long and 75 mm. wide. In the original description the figures indicating the widths of the second and the third had exchanged places. The fourth was fully as long as the third. The first costal scute is small, being about 36 mm. in fore-and-aft extent.

The plastron lacks the hinder extremity (plate 8, fig. 1; text-fig. 36). The total length must have been close to 205 mm. The breadth, measured on the mesoplastra and following the curves, is 186 mm. The median region is slightly concave as far outward as a ridge which joins the free border of the anterior lobe with that of the posterior lobe. From this ridge the lower surface slopes upward and outward to the outer borders of the plastral bones. The bridge has a fore-and-aft extent of 87 mm. The anterior lobe is short and narrow, the length being 52 mm.; the width at the base, 72 mm.; at the hinder ends of the epiplastra, 38 mm. The latter bones are small, and they meet along the midline, in front of the entoplastron, only 5 mm. The entoplastron is relatively large, the length being 28 mm.; the width, 17 mm. Seen from the upper surface, this bone is broadly spear-shaped, with an anteriorly directed process, a longer one directed backward, and a right and a left process. Its length on this upper surface is 33 mm. The free borders of the anterior lobe are rounded in section. The thickness of its various bones is about 7 mm.

On the upper surface of this plastron there is a low ridge passing from one axillary buttress to the other, making the thickness of the bone at the midline 9 mm. A similar thickening of the bones is found between the inguinal buttresses, the thickness becoming 11 mm.

The mesoplastral sutures are distinct everywhere except near the midline in front of the right mesoplastron. The left mesoplastron is 21 mm. wide at the midline and apparently 43 mm. at the outer end. The mesoplastron of the right side is only 36 mm. wide at the outer end.

Dimensions.	*Baëna hatcheri.*	*Baëna marshi.*	*Baëna callosa.*
Width of bridge.....	1.00	1.00	1.00
Length of anterior lobe	.92	.58	.60
Width of anterior lobe.	1.00	.79	.82
Width of hinder lobe..	1.04	.75	.94

The posterior lobe is 83 mm. wide at the base. It is flat below. On the upper surface there is a thickening parallel with the free border on each side. From the summit of the ridge thus formed the surface slopes to the acute border and toward the midline. Just behind the inguinal notch the thickness of the bone is 14 mm.; where the hypoxiphiplastral suture crosses the midline, only 4 mm. thick.

The sulci are in general distinctly developt. Those behind the intergular are somewhat obscure. The intergulars do not separate the gulars. The various scutes meet their fellows along the midline as follows: Intergulars, 12 mm.; gulars, 9 mm.; humerals, 32 mm.; pectorals, 41 mm.; abdominals 27 mm.; femorals, 40 mm. The length of the anals is indeterminable. They lie partly on the hypoplastral bones. On each bridge there are 3 inframarginals, whose outer borders rested on the bridge peripherals.

The table herewith is intended to present the most obvious differences in the proportions of the plastral bones in the three species, *B. hatcheri*, *B. marshi*, and *B. callosa*. The width of the bridge is taken as the unit.

It is seen that *B. hatcheri* has, relatively to the width of the bridge, large anterior and posterior lobes; that *B. marshi* has both lobes small; and that *B. callosa* has the anterior lobe short and of moderate width, while the hinder lobe is broad at the base.

The anterior lobe of the present species is narrower and more pointed than that described by Lambe (Cont. Canad. Palæont., III, 1902, p. 44, figs. 10, *a*, *b*) under the name *B. antiqua*.

Baëna antiqua Lambe.

Text-figs. 37, 38.

Baëna antiqua, LAMBE, Contrib. Canad. Palæont., III, 1902, p. 44, figs. 10, *a*, *b*.

The materials on which this species was based belong to the Canadian Geological Survey. They were collected in 1901, in the Judith River beds, on Red Deer River, British America, by Mr. L. M. Lambe, of the Canadian Survey. The type of the species consists of the median region of the anterior two-thirds of the carapace. Near it was found the greater part of the anterior lobe of the plastron, and this is believed to belong to the same individual.

Vertebral.	Length.	Width.
1	40	73
2	62	70
3	66	75

The front of the carapace (fig. 37) was apparently broad and rounded. The nuchal bone is 28 mm. fore and aft; 58 mm. from side to side. The neurals are irregular in form and outlines. The vertebral scutes are broader than long. The dimensions of the three present are given in the accompanying table.

No supernumerary costal appears on each side of the first vertebral, such as is found in many species of the genus.

The fragment of plastron (fig. 38) presents an entoplastron that differs from all others at present known in being lozenge-shaped and broader than long. Its length is 22 mm.; its breadth, 28 mm.

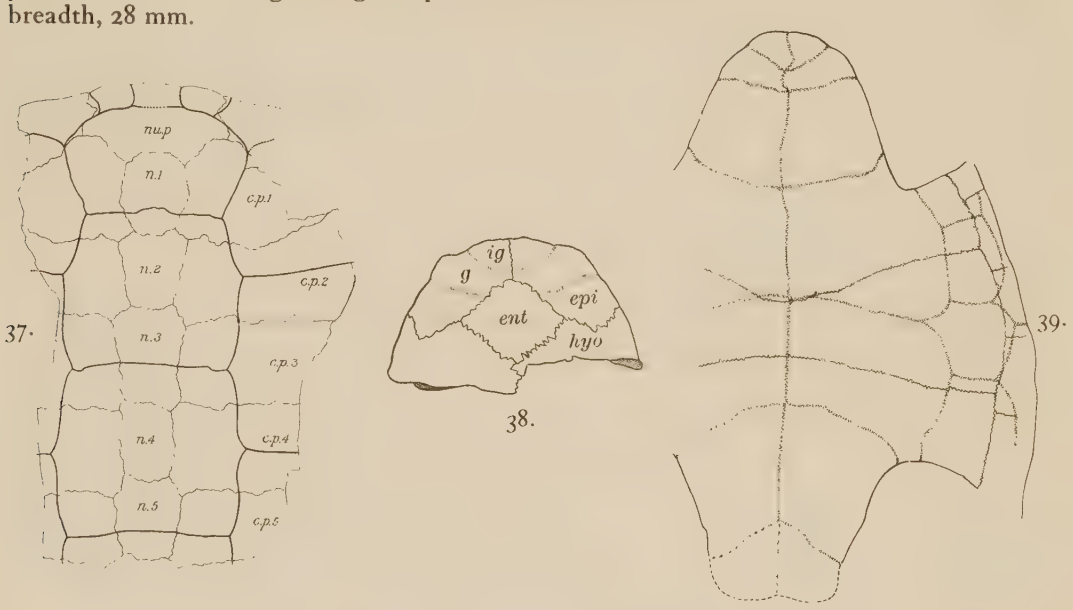


FIG. 37.—*Baëna antiqua*. Carapace. Type. ×⅓. Reduced from Lambe's original drawing. *c. p.* 1, etc., costal bones; *n.* 1, etc., neural bones; *nu. p.* nuchal bone.
FIG. 38.—*Baëna antiqua*. Anterior lobe of plastron. ×½. From drawing by Lambe.
FIG. 39.—*Baëna marshi*. Plastron of type. ×$\frac{3}{10}$.

Baëna marshi Hay.

Plate 8, fig. 2; text-fig. 39.

Baëna marshi, HAY, Amer. Jour. Sci., XVIII, 1904, p. 261, plate xi, text-fig. 1.

The type and only known specimen of this species comes from the Laramie deposits of Wyoming. It was collected in 1889, by Professor J. B. Hatcher, in Converse County, between Buck and Lance Creeks, and is now in the Yale University Museum.

The specimen is considerably damaged. There are present the cast of the greater portion of the interior of the shell, the greater part of the central portion of the carapace and most of the

left side, and a large part of the plastron. The length of the carapace is conjectural, but it appears to have been at least 300 mm. The width was 220 mm. Its composition can not be determined, since the bones have co-ossified and obliterated the sutures. In the median region the bones reach a thickness of from 10 to 13 mm. The outer surface is smooth. The sulci are narrow and shallow, and in most places are not traceable. The second, third, and fourth vertebral scutes varied from 65 to 70 mm. in width. The first and fifth were probably somewhat wider.

The hinder extremity of the plastron (plate 8, fig. 2; text-fig. 39) is missing, so that its form can not be determined. The anterior lobe has the right border nearly complete to beyond the midline in front, so that its form is known. The dimensions of the plastron are shown in the accompanying table. In order that the distinctness of the species from *B. hatcheri* may be seen, the dimensions of the latter are added.

Dimensions.	*Baëna marshi.*	*Baëna hatcheri.*
Length of plastron.....	260±	305
Width of the bridge.....	120	115
Length of anterior lobe..	70	106
Width of anterior lobe...	95	115
Length of hinder lobe...	65±	98
Width of hinder lobe....	90	120

The plastron is somewhat concave. The concavity extends laterally to a rounded ridge which runs from the outer border of the anterior lobe to the outer border of the posterior lobe. From this ridge the outer ends of the hyoplastron and hypoplastron extend upward and outward to the peripherals, and the elevation is continued on the latter to the carina which unites the free borders of the third and the seventh peripherals. From the midline of the plastron to the ridge is 55 mm.; from the ridge to the lateral carina is about 85 mm., the measurements being taken on the mesoplastron.

Most of the sutures of the plastron may be traced. The limits of the entoplastron are not determinable; nor have the sutures between the xiphiplastra and the hypoplastra been observed. The mesoplastra meet along the midline for about 23 mm. while their outer ends are 65 mm. wide. The sutures between the plastral bones and the bridge peripherals are distinctly shown. The whole width of the plastron, on the mesoplastra, and following the curves, is 215 mm.

The gular scutes appear to have met for some distance along the midline. The gulo-humeral sulcus runs nearly directly across the lobe and meets the median line 27 mm. behind the anterior border. The following are the antero-posterior dimensions of the various plastral scutes, measured along the midline: Intergulars, 17 mm.; gulars, 10 mm.; humerals, 46 mm.; pectorals, 50 mm.; abdominals, 47 mm.; femorals, 53 mm.; anals, 45 mm. On the bridge there are 4 inframarginals, of which the inguinal is the largest, and the axillary somewhat the smallest. The outer borders of these overlap on the bridge peripherals.

This species appears to differ from *Baëna hatcheri* in the smaller plastron, the longer bridge, and the greater thickness of the bones of the carapace, especially of the dorsal region. It is named in honor of Professor O. C. Marsh, formerly professor of vertebrate paleontology in Yale University.

Baëna hatcheri Hay.

Plates 9, 10; text-figs. 40, 41.

Baëna hatcheri, HAY, Ann. Carnegie Museum, 1, 1901, p. 325, plate xv.—HATCHER, Bull. U. S. Geol. Surv. No. 257, p. 79.

The type of the species is a very complete shell which was collected by Mr. J. B. Hatcher, in the year 1900, in the Ceratops beds of the Laramie formation, in Converse County, Wyoming. The locality given more particularly is 'a sandstone bluff on the south side of Lance Creek, opposite the mouth of Dolgie Creek. The specimen belongs to the collection of the Carnegie Museum.

The whole plastron is present and all of the carapace except a small portion of the rear. The sides of the carapace are somewhat crusht in, and some crushing has been suffered by the bridge peripherals; but these defects do not stand in the way of determining the characters of the species. It displays all the epidermal sulci and nearly all of the bone sutures. Moreover, the matrix, a soft sandstone, has been removed, so that the interior too can be observed.

The total length of the carapace (plate 9) was originally 368 mm.; the total breadth, 280 mm.; the height from the bottom of the plastron, about 145 mm. The greatest breadth of the carapace was somewhat behind the inguinal notches. From here the border rounds rapidly to the median excavation behind. The anterior end is rather pointed. In front, the margin of the carapace is unbroken by serrations or sinuses, except that the nuchal is slightly excavated. The hinder portion, from the inguinal notches backward, is scallopt as in the other species of the genus. It is also thin and rather acute. Even at the bridges the border was narrowly rounded.

FIG. 40.—*Baëna hatcheri*. Type. ×¼. Carapace.

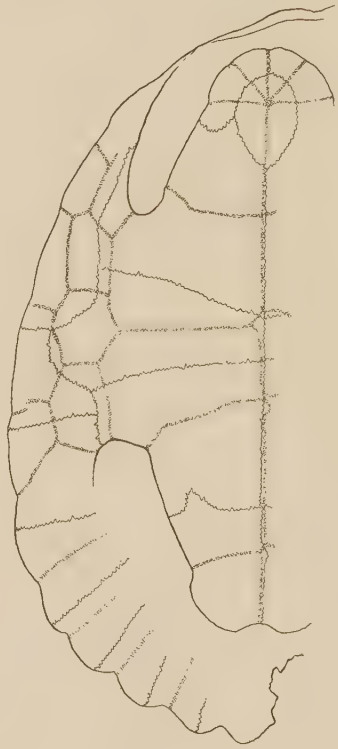


FIG. 41.—*Baëna hatcheri*. Type. ×¼. Plastron.

The sutures between the bones are fine and their course is often indicated by only the finely striated border of the adjoining bone.

The nuchal bone is nearly quadrate in form. It is 43 mm. long fore and aft, with a width of 59 mm. in front and a maximum width of 72 mm. The neurals in general are hexagonal, with the broader end forward. The table annext presents the dimensions of the neurals.

The single suprapygal had a length of 50 mm. and a width of 56 mm. No true pygal is interposed between the peripherals of the last pair.

The costal plates vary considerably in the fore-and-aft extent. Measured at their proximal ends they have the following widths: First, 48 mm.; second, 40 mm.; third, 47 mm.; fourth, 33 mm.; fifth, 47 mm.; sixth, 32 mm.; seventh, 32 mm.; eighth, 31 mm. The fifth costal presents the peculiarity of being very narrow at the distal end—only 9 mm.

Neural.	Length.	Width.
1	40	40
2	36	30
3	51	36
4	38	33
5	47	33
6	36	32
7	32	28
8	23	30

The peripherals are high, the first two about 38 mm.; the third, 33 mm.; the next three, about 52 mm.; the seventh, eighth, ninth, about 68 mm.; the tenth, eleventh, and twelfth, about 48 mm. The sutures between the peripherals behind the eighth are not visible, but they were probably not far removed from the lines representing them.

The epidermal scutes are all defined by sulci which are

distinct, but very narrow and shallow. The vertebrals are relatively wider than they are in any of the other species of the genus. From the first vertebral there is cut off on each side an accessory lateral scute, and this has much reduced its size; also, from its anterior end there is cut off a small supernumerary vertebral, so that there are really 6 vertebrals, as in *Chisternon*. The table herewith gives the dimensions of the vertebrals. The width of the central ones is really somewhat greater than the figures indicate, on account of some lateral compression.

The triangular supernumerary lateral scutes are each 39 mm. fore and aft, and 50 mm. from side to side.

The area usually occupied in turtles by the nuchal scute is broken up into 4 scutellæ unsymmetrical in form and size. Of these the extreme right and left are larger and much alike in form and size; the median two are much unlike, one being very small.

Behind the nuchal scutellæ there are 13 marginals on each side. Usually the costo-marginal sulci run along some distance below the costo-peripheral sutures. The first marginal extends back from the border of the shell only 16 mm.; the fourth, 40 mm.; the sixth, 55 mm., and rises above the costo-peripheral suture; the eighth, 53 mm.; the eleventh, 41 mm. The thirteenth is considerably smaller than the twelfth. As in other species of *Baëna*, there was no supracaudal scute.

The plastron (plate 10) is rather narrow, especially the hinder lobe. Its total length is 305 mm. The bridge has a width, fore and aft, of 115 mm.; a length, from the inner end to the border of the carapace, of 95 mm. It rises considerably from the inner end to the outer. The anterior lobe is 106 mm. long; 115 mm. wide at the base. The width diminishes gradually to the gulo-humeral sulcus, then rapidly to the midline in front. The thickness of the border of the lobe is about 8 mm.; behind the entoplastron, about 6 mm.

The hinder lobe is 98 mm. long; 120 mm. wide at the base. The lateral borders are nearly straight and convergent to the ends of the femoro-anal sulcus. Here the width is 71 mm. Behind this, the sides are nearly parallel for a short distance; then they round rapidly to the shallow hinder excavation. Just behind the inguinal notch the thickness is 18 mm.; near the hinder extremity, only 7 mm.

Vertebral.	Length.	Width.
1	19	32
2	50	83
3	75	90
4	80	90
5	90	91
6	55	88

The entoplastron is oval, 47 mm. long and 36 mm. wide. The hyoplastrals extend along the midline 85 mm., and each reaches laterally, behind the axillary notch, 105 mm. There are large mesoplastrals. The median ends are 24 mm. wide, the lateral ends, 61 mm. Each extends outward from the midline 125 mm. The hypoplastrals join along the midline for the distance of 75 mm.; the xiphiplastrals, 60 mm.

The intergulars and gulars are of about the same form and size, all starting from a point near the front of the entoplastron. The humerals are 63 mm. long and meet for some distance behind the entoplastron. The pectorals occupy about 54 mm. of the midline; the abdominals, about 48 mm.; the femorals, about 78 mm.; the anals, 37 mm.

On the bridge of each side are seen 4 large inframarginals. These lie principally on the plastral bones, but partly on the peripherals.

The hyoplastra and hypoplastra send upward strong buttresses against the inner surfaces of the first, and of the fifth and sixth costals respectively; but these buttresses, especially the inguinal, do not extend inward so far as they do in the other species of the genus. The axillary buttress is directed upward and forward toward the front of the first dorsal vertebra. Its inner border is acute. At its upper end the buttress joins the first rib, which is wide and furnisht with a sharp border; thus the partition bounding the sternal chamber anteriorly is carried up to the first dorsal vertebra. The inguinal buttress, seen from behind, appears to be about 30 mm. wide; but in front of it the sternal chamber extends far out toward the border of the carapace.

Baëna escavada sp. nov.

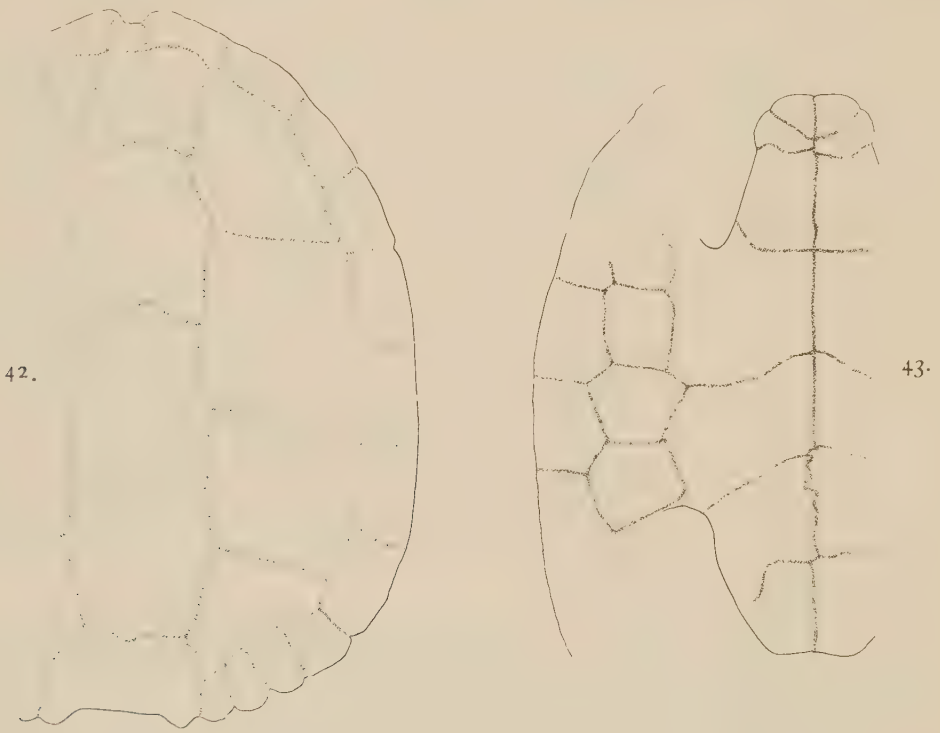
Plate 11, figs. 1, 2; text-figs. 42, 43.

The chelonite on which this species is based was obtained by Dr. J. L. Wortman and Mr. Walter Granger in 1896, in the Torrejon deposits, at the head of Escavada Creek, in New

Mexico. The specimen is not quite complete, being somewhat crusht and fractured and having a portion of the margin of the left side missing.

The species closely resembles the others of the genus, but possesses sufficiently distinctive characters. The specific name is that of the stream near which the specimen was found. The catalog number is 1203, of the American Museum of Natural History.

All traces of the sutures between the bony elements of the shell are obliterated thru co-ossification. The sutures between the epidermal scutes are distinct, but narrow and only moderately imprest. The total length of the carapace (plate 11, fig. 1; text-fig. 42) is 381 mm. In the midline the length is about 12 mm. less, on account of the slight emargination in front and the excavation in the rear. The breadth was close to 300 mm. The carapace is broad, ovate, obtusely pointed in front, truncate behind. On each side of the anterior emargination the border was gently repand. The hinder border, on each side of the excavation for the tail, was scallopt. On the hindermost part of the carapace there is a moderate rounded keel. From this there may be traced forward faint indications of the two parallel grooves so distinct in *B. arenosa*. Except these grooves, the ornamentation seen in the latter species is absent.



FIGS. 42 AND 43.—*Baëna escavada*. Type. $\times\frac{1}{4}$. Form of shell and the scute areas.

42. Carapace. 43. Plastron.

The most distinctive character of this species is seen in its narrow and spatulate anterior plastral lobe (plate 11, fig. 2; text-fig. 43). The plastron as a whole is relatively small. The total length is 295 mm. The anterior lobe has a length of 83 mm. and a breadth, at its base, of 96 mm. From the base the lateral borders run forward and inward to within 30 mm. of the front, at the ends of the sutures between the gular and humeral scutes. Here the width is 61 mm. Beyond these points the lobe expands again to 64 mm.; then curves forward and inward to the ends of the intergular sutures. The extreme end of the lobe is truncated and falls about 30 mm. short of the anterior border of the carapace.

The posterior lobe has a width of 114 mm. at the base and a length of 75 mm., failing to reach the excavation in the carapace by about 47 mm. It narrows, as it passes backward, more rapidly than does that of *B. arenosa*. The hinder border is slightly concave.

The bridge has a width of 135 mm. Its length, to outer margin of the shell, is 105 mm.

The vertebral scutes are relatively narrow, the second having a length of 88 mm. and a width of 65 mm.; the third a length of 85 mm. and a width of about 70 mm.; the fourth a length of 80 mm. and a width of 70 mm.; the fifth a length of 48 mm. and a width of 80 mm. In the case of the first vertebral the same lack of symmetry is to be seen as has been observed in so many other specimens belonging to the genus *Baëna*.

The costo-marginal sulci are distant from the edge of the carapace about 22 mm. Those subdividing this anterior marginal region are too obscure for certain determination. There are indications of one which crost this region about 15 mm. to the left of the midline. There was, therefore, probably a nuchal scute 30 mm. long from side to side. Beyond this the marginals increase in length and breadth. Over the bridge they rise on the sides of the carapace 45 mm.

On the plastron are distinct gulars and intergulars. The humero-pectoral sulcus crosses the midline on the line joining the axillary notches. Laterally the sulcus is suddenly turned forward and outward. The pectoral scutes meet along the midline for a distance of 53 mm., and extend laterally about 72 mm. The abdominal scutes occupy 52 mm. of the midline; the femorals 67 mm.; the anals 50 mm. As in other species of *Baëna*, the suture between the femorals and the anals runs outward, then turns backward for some distance, then again outward.

There are 4 large inframarginals.

Baëna arenosa Leidy.

Plate 12; plate 13, fig. 1; plate 14, figs. 1–3; text-figs. 44–51.

Baëna arenosa, LEIDY, Proc. Acad. Nat. Sci. Phila. 1870, p. 123; U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 367; U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 368; Contrib. Ext. Vert. Fauna W. Terrs., 1873, pp. 161, 343, pl. xiii, figs. 1–3; ?pl. xv, figs. 1–5; pl. xvi, figs. 8, 9.—COPE, ?Append. LL of Ann. Report Chief of Engineers, 1875, p. 96; ?Wheeler's Surv. 100th Merid., 1877, p. 52, pl. xxiv, fig. 32.—BAUR, Proc. Acad. Nat. Sci. Phila. 1891, p. 426, fig.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 437.

Baëna affinis, LEIDY, Ann. Report U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 367.

Baëna arenosa, the type of the genus *Baëna*, was based on a shell lacking only the anterior lobe of the plastron and the anterior border of the carapace. This specimen is now in the United States National Museum at Washington. It was figured and described at length in Dr. Leidy's work of 1873. The specimen was obtained in the Bridger deposits, at the junction of the Big Sandy and Green Rivers, in southwestern Wyoming. These beds are regarded as belonging to the lowermost of the Bridger formation.

The specimen described by Leidy evidently had originally a length of close to 340 mm. and a width of 288 mm. The rear of the carapace is broadly rounded. The vertebral scutes are broader than long. The hinder lobe of the plastron is broad and it narrows slowly backward. The width of the anterior lobe, taken from the outer ends of the humero-pectoral sulci, equals half the length of the plastron behind this. Dr. Leidy states that the position of the former sutures can not be detected. This is true as regards the outer surface of the bones; but on the upper side of the plastron the sutures on each side of the mesoplastrals are to be observed. The left mesoplastron had a width of about 25 mm. at the midline; that on the right side was narrower.

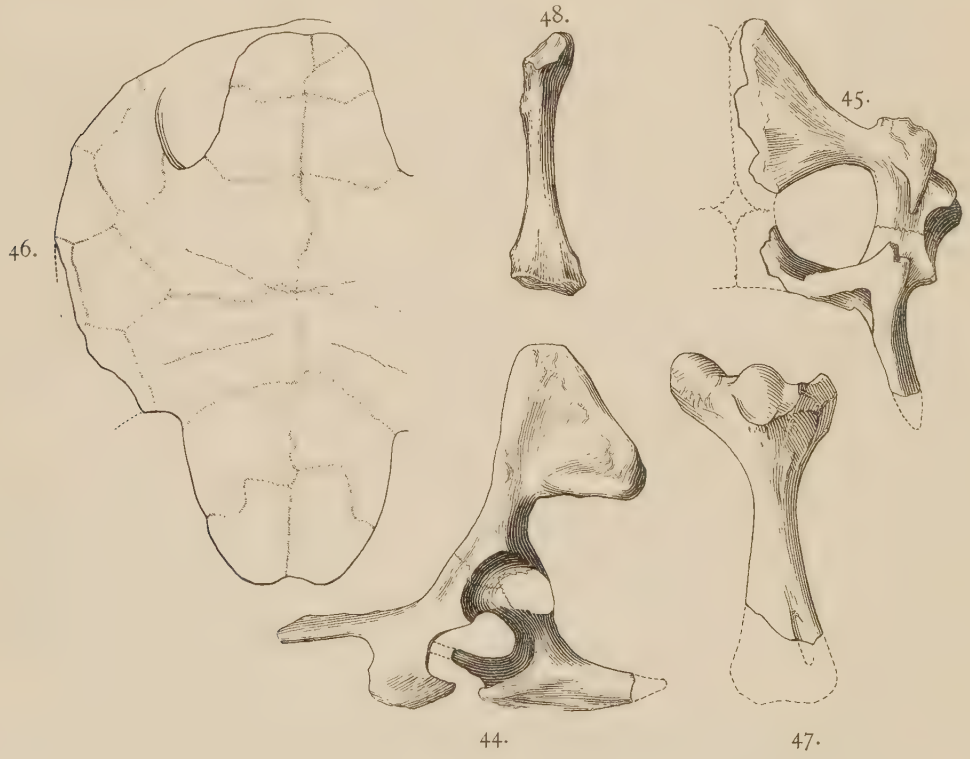
A portion of the pelvis and the sacral vertebræ and ribs of this specimen were figured by Dr. Leidy. Later, Dr. Baur obtained from the matrix of the specimen additional parts of the pelvis and briefly described them. While some parts are still wanting there is enough to show that the ischia were united with the pubes along the midline and that the pubes extended at least 35 mm. in front of their hinder border at the midline (figs. 44, 45). The upper end of the ilium was expanded backward. The width of this expanded part was equal to the height, 35 mm.

The writer follows Dr. Leidy and Professor Cope in identifying the former's *B. affinis* as the earlier described *B. arenosa*. The original description of *B. affinis* was exceedingly brief and hesitating. It was supposed to be distinct from *B. arenosa* because of the presence of only 3 inframarginals. In Leidy's next reference to the species, he referred it to his earlier *B. arenosa*. The type is now in the collection of the Philadelphia Academy. It was

obtained at Church Buttes, in the level known as B. Dr. Leidy's figure makes the anterior lobe of the plastron appear too short and too narrow. The plastron has a total length of 275 mm. The anterior lobe is 75 mm. long and 70 mm. wide at the base. The bridge has a width of 123 mm. The hinder lobe is 77 mm. long and 110 mm. wide at the base. The carapace has a length of 300 mm. in a straight line. The surface is uneven, especially within the areas of the vertebral scutes. There appear to have been no supernumerary costal scutes. The dimensions of the vertebrals are given in the accompanying table.

Vertebral.	Type of *B. affinis.*		No. 5973 A. M. N. H.	
	Length.	Width.	Length.	Width.
1	50	72	48	60
2	73	61	72	67
3	73	64	77	74
4	60	63	62	69
5	55	75	57	77

The American Museum expedition of 1903 collected a number of specimens which must be referred to this species. The most important of these is No. 5973, collected at Grizzly Buttes, Wyoming. It furnishes a somewhat damaged shell; the skull, lacking the left side and the lower jaw; a portion of the shoulder-girdle; the humerus, lacking the distal end; and the ulna. The length of the carapace (plate 12) in a straight line is 330 mm., to the bottom of the posterior notch, 320 mm.; its width, about 315 mm. The bones are thoroly co-ossified and the sutures obliterated. The anterior border projects somewhat at the midline. The posterior border is broad, with a median excavation 60 mm. wide and lateral scallops.



FIGS. 44–48.—*Baëna arenosa*. No. 5973 A. M. N. H.

44. Pelvis seen from left side. ×⅔.
45. Left half of pelvis seen from below. ×⅔.
46. Plastron. ×¼.
47. Left humerus. ×⅔.
48. Right ulna. ×⅔.

On each side of the first vertebral there is a small supernumerary costal scute. Along the midline there is a narrow ridge and within the areas of the vertebral scutes a number of symmetrically arranged ridges. The dimensions of the vertebrals are given in the table above.

The plastron (plate 13, fig. 1; text-fig. 46) is 287 mm. long. The anterior lobe is 77 mm. long; 104 mm. wide at the base; and 77 mm. at the gulo-humeral sulcus. The limits of the entoplastron can not be traced. The bridge is 125 mm. wide. By means of the striations on the

bones the limits of the mesoplastrals can be pretty well determined. They appear to have joined each other at the midline for a distance of about 25 mm. The hinder lobe is 84 mm. long; 114 mm. wide at the base; and 92 mm. wide at the gulo-humeral sulcus. At the rear there is a broad and shallow notch. The plastral scutes offer no especial deviations from the normal. Their forms and dimensions may be determined from the figure. On each of the bridges there are 3 inframarginals.

The right humerus (fig. 47) lacks the distal end. Its length has been approximately 70 mm. The resemblance to that of *Chelydra* is close. The head is, however, not so large, and especially it is comprest in a plane perpendicular to the dorsal surface of the bone. Furthermore, the plane of this comprest head inclines to the radial side of the humerus; whereas, in *Chelydra*, it falls far outside of the ulnar side. The ulnar and radial processes are large and the distance from the outside of one to the outside of the other measures 32 mm. In the case of the humerus of the type of *B. riparia* this distance is only 26 mm. In *B. arenosa*, as well as *B. riparia*, the planes of the two processes are at right angles with each other, as in *Chelydra*. The processes are much thicker than in *Chelydra*. The shaft has a diameter of 8.25 mm. The groove leading to the ectepicondylar foramen is broad and deep. A fragment from near the distal end of the left humerus has a width of 21.5 mm. The right ulna (fig. 48) is present. The shaft is not flattened like that of the Cryptodira, but is nearly cylindrical, like that of *Hydromedusa*. The articulation for the humerus is, however, like that of the Cryptodira. The bone is 52 mm. long; 15 mm. wide at the distal end.

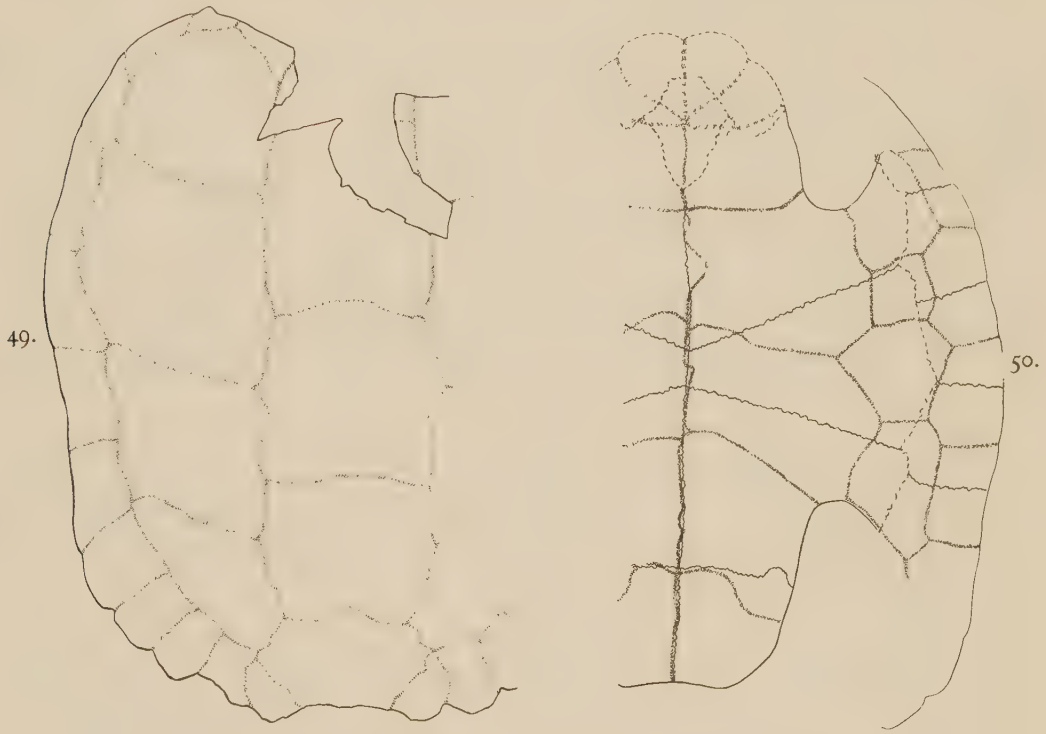
Plate 14, figs. 1–3, represents what is left of the skull. The occipital condyle and the premaxillæ are wanting, but the length between these two was close to 60 mm. The greatest width (plate 14, fig. 1) just in front of the tympanic cavities was 62 mm. From the tips of the nasals to the extremity of the supraoccipital is 57 mm. All the sutures of the roof of the skull are obliterated. The tympanic cavity (plate 14, fig. 2) has a horizontal diameter of 15 mm. and a vertical of 18 mm. The stapedial rod remains in its natural position. The eyes appear to have lookt upward and outward more than in *Chisternon hebraicum* (fig. 78, p. 89), and were smaller. The orbits are circular with a diameter of 16 mm. The interorbital space is 22 mm.; the nasal opening, 20 mm. wide; the maxilla, below the eye, 10 mm. wide. Seen from below (plate 14, fig. 3), the cutting-edge of the maxilla is sharp, thickened upward to 5 mm., and at least 30 mm. long. There is a prominent ridge on the triturating surface of the maxilla, highest on each side of the choanæ. The least width across the pterygoids is 13 mm. From the outer posterior angle of the basioccipital bone a strong ridge runs forward toward the basisphenoid. The basisphenoid did not come into contact with the vomer. Unfortunately, the lower jaw is missing.

On the upper side of the skull are seen numerous anastomosing grooves, the boundaries of horny scutes that covered most of the upper surface. Some of these are represented in fig. 1, plate 14.

The skull differs from that of *Chisternon hebraicum* in having a wider interorbital space, a smaller eye, and far more prominent masticatory ridges on the upper jaws. It is most like that of *B. riparia*. Unfortunately, both skulls are damaged, so that full comparison is not possible. The two skulls are of almost exactly the same size. The snout of *B. arenosa* was broader, as was also the interorbital space. The eye of *B. riparia* appears to have had a greater vertical diameter, but of this we can not be certain at present. In *B. riparia* the maxilla below the orbit is only 9 mm. wide. In *B. riparia* the ridge along the junction of the basisphenoid and the pterygoid is far less prominent. In this species, too, there is a low ridge running from the pedicel of the quadrate to meet the free border of the pterygoid. Another, starting from the same point, runs forward and upward along the suture between the quadrate and the pterygoid. The surface of the bone between these two ridges is somewhat scoopt out. In *B. arenosa* the ridges are little developt and the space between them is convex.

No. 1115 of the American Museum is identified as belonging to the present species. It was collected by the museum's expedition of 1893 into southwestern Wyoming. The locality whence it was obtained is Laclede Meadows, southwest of Bitter Creek station and west of Haystack Mountain. The deposits belong to the Washakie formation. Of this individual the front and a part of the right border of the carapace (fig. 49) and the front of the anterior lobe of the plastron (fig. 50) are missing. The remainder of the shell is well preserved. It had origi-

nally a length of about 395 mm., measured in a direct line. The greatest width, 340 mm., is across the middle of the length of the carapace. Across the axillary notches the width is 315 mm., and that taken 25 mm. in front of the hinder extremity of the plastron is 306 mm. It will be seen therefore that the extremities of the shell are broad. The height of the shell is now 145 mm. but it was doubtless greater during life.



FIGS. 49 AND 50.—*Baëna arenosa*. $\times\frac{1}{4}$. No. 1115 A. M. N. H.

49. Carapace. Shows the scute areas. Front injured.
50. Plastron. Shows many of the bones and the scute areas. Front restored.

The hinder border of the carapace (fig. 49) is rather thin and acute, scallopt as in the other species of the genus, and flared somewhat upward. The anterior border is obtuse. All the bones are thoroly co-ossified, so that the forms of the neurals can not be determined. The surface is uneven, and especially in the areas occupied by the vertebral scutes there are various longitudinal, transverse, and oblique ridges. A slight depression occupies the midline of vertebrals 3 and 4. The accompanying table gives the dimensions of the vertebral scutes. In general, they are wider than long.

Vertebral.	Length.	Width.
1	..	73
2	96	91
3	90	95
4	80	90
5	75	100

As is not infrequent in the species of the genus, there are, on the left side at least, 5 costal plates. The most anterior is cut from the front of the one usually called the first; altho the most anterior vertebral is reduced somewhat in width thereby. The portion of the rim of the carapace between the outer border of the small anterior costal scute and the posterior vertebral is occupied by 12 marginal scutes.

The plastron (fig. 50) has an even, but granulated, surface. The anterior lobe is 133 mm. wide at the base. The bridges are 155 mm. wide. The limits of the mesoplastra are indistinctly discernible. They were about 20 mm. wide at the midline and expanded distally to about 90 mm. The hinder lobe is 141 mm. wide at the base and 105 mm. long. It diminishes in width slowly backward and the end is truncated. At the ends of the femoro-anal sulci the width is yet 113 mm. The lobe lacks about 60 mm. of reaching backward to the hinder border of the carapace.

On the left bridge there are four inframarginal scutes. Of these the second is the smallest, the first and the fourth the largest. All the plastral, as well as the carapacial scutes, agree closely with those of Leidy's type.

A portion of the pelvis is preserved (fig. 51). So far as can be determined, it agrees well with that of the type of the species. Unfortunately, the upper end of the ilium is missing.

Professor Cope figured and described what he regarded as a specimen of *B. arenosa* (Vert. Tert. Form. West, p. 148, plate xvii, figs. 1, 2). The specimen is in the American Museum and has the number 1112. The present writer regards it as belonging to *B. riparia*.

Professor Cope has described and figured also a portion of a carapace found by him in the Wasatch beds of New Mexico. As the type of *B. arenosa* was discovered in the lowermost beds of the Bridger, it is not impossible that the species may occur in the Wasatch; but the identification based on a part of the shell is not to be depended upon.

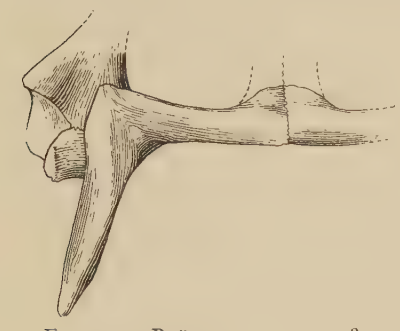


FIG. 51.—*Baëna arenosa*. $\times\frac{2}{3}$. Pelvis seen from below.

However, the American Museum expedition of 1906 into the Wasatch deposits of Wyoming secured a specimen of *Baëna* which is referred to this species. This was found near Knight's Station, not far from Evanston. The level was about 200 feet above Bear River. The catalog number of the specimen is 6041. About one-third of the carapace in front has been eroded away, but otherwise the shell is in fair condition. The length of the carapace was originally about 240 mm. The width at the middle of the length is 222 mm., and this width is fully maintained to opposite the ends of the femoro-anal sulci. So far as can be determined this specimen differs from most Bridger specimens in the greater smoothness of the areas of the vertebral scutes; but this appears to have been nearly the condition of Leidy's type. Cope's specimen obtained in the Wasatch of New Mexico and referred by him to the present species had the back sculptured as in most Bridger specimens. It appears best, until more is known about the Wasatch form, to identify it as *B. arenosa*.

Baëna sima sp. nov.

Plate 13, figs. 2, 3; plate 14, figs. 4–6; plate 15; text-figs. 52–56.

The present species has for its type No. 5971 of the American Museum of Natural History. This specimen was collected by that museum's expedition of 1903 into the Bridger beds. The locality is on Little Dry Creek, south of Fort Bridger, and the level is that designated as B. The specimen furnishes nearly the whole of the shell, the skull, with the lower jaw, a number of vertebræ, and portions of the limb bones.

The bones of the shell are so thoroly co-ossified that few of the sutures can be made out. The carapace (fig. 52) has an axial length of 360 mm.; the width was close to 260 mm. It was apparently rather elevated. There is no depression along the midline. In outline the carapace was pointed in front and somewhat contracted behind. Posteriorly there is in the border, over the tail, a rather deep excavation 72 mm. wide. The posterior peripherals are flared upward. The surface of the carapace is very uneven, being everywhere covered with coarse pustular elevations; just outside of the third and fourth vertebral scutes there are some longitudinal wrinklings. About 25 mm. outside of these vertebrals there are seen on each side distinct traces of a lateral carina. The median symmetrically arranged folds and grooves seen in *B. arenosa* are here quite indistinct.

Vertebral.	Length.	Width.
2	76	68
3	81	69
4	79	82
5	58	83

The nuchal scute has a fore-and-aft width of 16 mm. and a transverse extent of about 40 mm. The first vertebral is 51 mm. long and 80 mm. wide; but there appears to be on the left side a small supernumerary costal scute cut out of its normal area. The other scutes have the areas given in the table.

Outside of the nuchal scute there is, on each side, a minute triangular marginal scute. The next one, the second, is 21 mm. long on the free border and 21 mm. high. The third is

38 mm. long and 15 mm. high. The seventh, lying below the hinder half of the second costal, is 56 mm. long and it rises about 36 mm. above the free border of the shell. On account of the obtuse border over the bridge the elevation of the lateral scutes is difficult to estimate.

The plastron (fig. 53) is 320 mm. long. The anterior lobe is 92 mm. long, 112 mm. wide at the base, and 80 mm. wide at the gulo-humeral sulci. The bridge has a width of 138 mm., 60 per cent. of the length of that part of the plastron behind the axillary notches. The hinder lobe is 92 mm. long, 127 mm. wide at the base, and 92 mm. at the ends of the femoro-anal sulci. The hinder border is slightly excavated.

The mesoplastra are solidly co-ossified with the contiguous bones, but some traces are found of the sutures. The bones appear to have been about 15 mm. wide at the midline.

The forms of the various plastral scutes are shown in the figure. The course of the median sulcus is very tortuous and there are some irregularities in the others. The axillary region is damaged on both sides, but appearances indicate that there were 3 left inframarginals, the

52. 53.

FIGS. 52 AND 53.—*Baëna sima*. Type. $\times\frac{1}{4}$. Showing the form of carapace and plastron and the scute areas.

52. Carapace. 53. Plastron.

pectoral scute apparently having extended out to the marginals. There is a large inguinal inframarginal and another in front of it. There was doubtless an axillary scute, but the bones are missing which supported it. On the right side there were 4 inframarginals.

The skull of this species (plate 13, figs. 1, 2; plate 14, fig. 4) is remarkable for its breadth and shortness. The premaxillary region is missing and likewise the condyle of the basioccipital; but the length from one to the other was very close to 64 mm. The breadth across the quadrates is 71 mm. From the quadrates the outline of the skull contracts rapidly to below the front of the orbits, where there is a sudden constriction. From this the outline contracts slowly, then rounds into the broad snout. The upper surface is convex. All the bones are solidly co-ossified, and no sutures are to be traced.

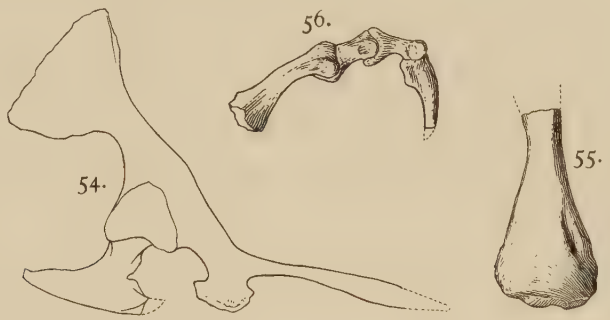
The temporal fossæ are rooft over extensively, so that between the end of the short supraoccipital and the postero-lateral angles there is on each side only a shallow sinus. The interorbital space is 26 mm. wide. The orbits have their greatest diameter, 17 mm. directed per-

pendicularly, while the horizontal diameter is only 14 mm. The narial opening is 21 mm. wide and it looks strongly upward as well as forward. The bones roofing it are 6 mm. thick. The tympanic region is damaged, but the vertical diameter was 20 mm. The quadrate is deeply notcht for the passage of the stapedial rod.

At their narrowest part the pterygoids are 14 mm. wide. There are large postpalatine foramina. The front of the choanæ is placed 17 mm. behind the premaxillæ. The cutting-edges of the maxillæ converge at nearly right angles. The triturating surface is 7 mm. wide. At its inner border, on each side of the choanæ, arises a sharp crest. These crests converge to the front of the choanæ, then run parallel to near the premaxillæ, thus producing a deep groove in front of the choanæ.

The lower jaw (plate 14, figs. 5, 6) is thick and heavy. From the middle of a line joining the front borders of the articulation for the quadrates to the tip of the jaw is 40 mm. This line prolonged backward even with the extremities of the rami would measure about 52 mm. while the greatest width was 60 mm. The triturating surfaces are concave transversely, and are 7 mm. wide. The middle of each ramus is 9 mm. thick and 15 mm. high. The tip of the jaw is turned upward, beak-like. The length of the symphysis on the lower side is 21 mm.

The upper surface of the skull was undoubtedly covered with numerous horny scutes. These are shown, as far as determined, in plate 13, fig. 1. They are somewhat irregular in form and disposition, but there is no difficulty in making out some symmetry in their arrangement. The horny covering of the maxillæ appears to have been divided, for a deep sulcus runs downward from the front of the orbit to the cutting-edge.



FIGS. 54–56.—*Baëna sima*. No. 5907 A. M. N. H.

54. Pelvis, right side. ×½. 56. Digit. ×⅔. 55. Distal end of humerus. ×½.

Accompanying the shell of this specimen are various portions of the internal skeleton, mostly fragmentary, however. The left humerus is represented by the proximal and the distal ends. The proximal shows a width, from the outside of the ulnar to the outside of the radial process, of 33 mm., a single millimeter more than in the specimen of *B. arenosa*, No. 5973, above described. Nevertheless, the long diameter of the head is 14.5 mm.; that of No. 5973, 13 mm. The ulnar process has a thickness of 11 mm.; that of No. 5973 a thickness of 9 mm. The distal end of this bone is 27 mm. wide. The trochlea has a narrow rounded ridge for the head of the radius and a broader one for the head of the ulna, the two being separated by a groove. Above the trochlea is a deep olecranon depression. The prepubic process resembles that represented in fig. 86, but it is thin and flat. With this specimen are found 3 conical dermal bones whose bases were buried in the skin, the remainder being covered with horn. Two of these are symmetrical and may have been placed on the midline of the upper side of the tail, as in *Chelydra*. However, they are not comprest, but circular in section. The base of one is 10 mm. in diameter and the height is the same; the other is smaller. The third is unsymmetrical and somewhat flattened. It is possible that on the tail were 3 rows of dermal bones or there may have been dermal bones on the legs, as in some species of *Testudo*.

No. 5965 may be regarded as the paratype of the present species. It furnishes only the carapace and plastron. It was secured in 1903, at Grizzly Buttes, Wyoming. The carapace is more complete than that of the type and has furnisht plate 15. The length is 333 mm. along

the midline. The height, after some crushing, is still 132 mm. The scallops of the hinder border are shallow. The surface of the carapace is sculptured as in the type. The symmetrical ridges and grooves found in *B. arenosa* and *B. riparia* are here obscure. On the hinder half of the carapace there are a few irregular longitudinal folds and a system of anastomosing ridges and pustular elevations. The outer ends of the costal scute areas, the marginal areas, and the whole anterior half of the carapace are much smoother. The nuchal scute is not divided. On each of the bridges there were four inframarginal scutes. The bridge region of fig. 53 has been completed from this specimen.

No. 5907 of the American Museum was collected in 1903 by the writer at Grizzly Buttes, Wyoming. It may be regarded as a second paratype. It furnishes the shell, fragments of the skull, the pelvis, and some limb bones. The shell appears not to have been distorted by pressure. The plastron has exactly the length of that of the type. The width of the carapace is 290 mm.; the height above the bottom of the plastron, 150 mm. On the right bridge there are only 3 inframarginal scutes, and the pectoral scute joins the sixth marginal. On the carapace the nuchal scute is not divided longitudinally. On each side, as in the other specimens, is a small marginal followed by a much larger one, that on the right side being larger. The supernumerary costals are not found at the sides of the first vertebral.

The pelvis is represented by fig. 54. The shaft of the ilium, where narrowest, has a diameter of 10 mm. The expanded head is 34 mm. high and 33 mm. wide, while in *Chisternon undatum* the head is considerably higher than wide. The pubis is thin, 4.5 mm., slightly convex above, concave below. The pelvis resembles closely that of the type of *B. arenosa*.

Fig. 55 is that of the distal end of the humerus, seen from above. The radius is a terete bone 57 mm. long. Fig. 56 represents one of the digits. The right femur is 78 mm. long and is a stout bone with a minimum diameter of 8 mm. The plane passing thru the strongly comprest head falls outside the tibial border of the distal end far less than in a specimen of *Trachemys elegans*. The tibia had a length somewhat exceeding 63 mm., and the least diameter of the shaft is 7 mm. The distal end of the fibula has a width of 13 mm.

The greater portion of the lower jaw is present and it is of the same heavy construction as that of the type. Fragments of the roof of the skull show that the bones in the midline, behind the orbits, were 7 mm. thick.

Baëna clara sp. nov.

Plate 16, figs. 1, 2; text-figs. 57, 58.

This species is based on a nearly complete shell which was collected by the American Museum expedition of 1893. It was obtained in the Bridger beds of Wyoming and bears the number 1675. The exact level and locality are not known. Only unimportant portions of the front of the carapace are wanting.

The extreme length of the carapace (plate 16, fig. 1) is 362 mm.; its width across the middle, where it is widest, is 300 mm. The shell is but little distorted by pressure. It is elegantly oval in form, with the edges of the hinder border of the carapace furnisht with shallow scallops, and with a deep excavation in the rear, as if for a large tail. The shell is flat transversely in the region occupied by the vertebral scutes. There is no carina, except along the fifth vertebral scute. Immediately in front of this, for a short distance, there is a narrow median ridge, like that seen in *B. arenosa*. Over and behind the posterior legs the shell is flared outward and slightly upward. In front and behind the bone is rather thin; but anteriorly it soon thickens, so that over the fore legs it has a thickness of about 15 mm. At the sides the margins of the shell are massive.

The carapace is smooth, with only some faint indications of the sculpturing seen in *B. arenosa*.

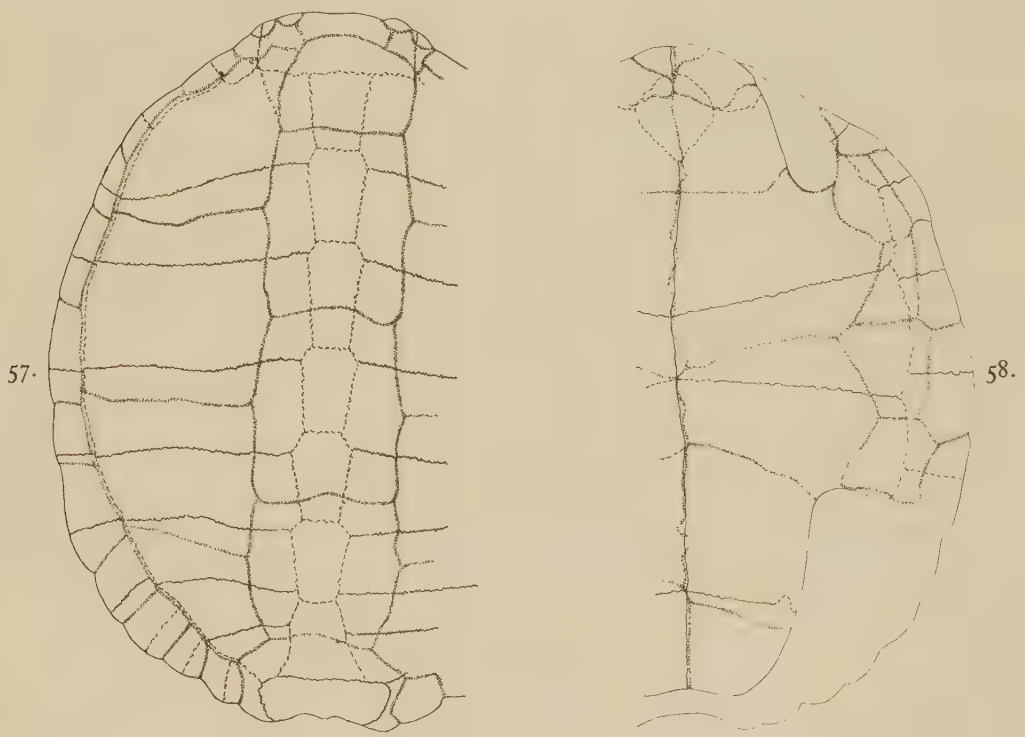
The plastron (plate 16, fig. 2; text-fig. 58) has a length of 333 mm. in the midline. It was flat as far out as the bridges. From the inner ends of these the plastron rises upward and outward to the margins of the carapace, so that the latter stands some 50 mm. above the level of the plastron. The highest part of the shell stood above the plastron about 150 mm.

The anterior lobe of the plastron is tongue-shaped, rounded in front, and feebly notcht. In the figures it appears foreshortened, having been prest upward during fossilization. Its

width at its base is 125 mm.; its length in the middle line is 90 mm. At a point half-way between the tip and the base the width is 88 mm. The width of the bridge is 145 mm. The hinder lobe of the plastron is broadly tongue-shaped, with the tip truncated and broadly notcht. At its base this lobe is 125 mm. wide; and in the midline it is 100 mm. long.

The sutures between the various bones of the shell are usually very obscure, but most of them are determinable. The limits of the neurals (fig. 57) are somewhat conjectural. Those between the costals and the peripherals run probably close to the sulcus between the costal and peripheral bones. The most anterior peripherals, however, rise above this sulcus.

The sutures of the plastron are hard to trace. Only the general course of those limiting the entoplastron and the epiplastra is discernible. The sutures between the bones of the plastron and the peripherals lie about 44 mm., mesiad of the shell margin. At a point about 40 mm. behind the axillary notch is observed the suture between the hyoplastron and the mesoplastron. Its course is inward and somewhat backward to a point in the midline about 66 mm. behind the line joining the axillary notches. Another distinct suture may be observed about 38 mm. in front of the inguinal notch on the left side. It can be traced toward the midline, where it becomes obscure. This suture is that between the mesoplastron and the hypoplastron. Thus the inner ends of the mesoplastron are about 24 mm. wide.



FIGS. 57 AND 58.—*Baëna clara*. Type. ×¼.

57. Carapace. 58. Plastron.

At a point in the midline about 45 mm. behind a line joining the inguinal notches the sutures between the hypoplastra and the xiphiplastra are seen running nearly directly outward.

The impressions defining the epidermal scutes are usually very distinct. The sides of the vertebral scutes are bracket-shaped. The lateral boundaries of the first vertebral run nearly parallel and the scute is nearly as wide in front as it is behind. It has a length of 56 mm., a posterior breadth of 63 mm., and an anterior breadth of about 58 mm. The lateral sulcus on the left side is deflected somewhat toward the right side as it passes forward. It is possible that an accessory lateral scute is cut off from the front of the usual first lateral scute and lies to the left of the first vertebral. It is provisionally represented in the diagram above.

The second vertebral scute is 90 mm. long in the midline, and is 72 mm. wide across its middle. Similarly, the third scute is 87 mm. long and 72 mm. wide; the fourth, 75 mm. long, deeply concave behind, and 75 mm. wide. The fifth scute is 35 mm. long and 100 mm. wide. Its posterior edge comes to the border of the shell, there being no supracaudal.

The anterior marginals are somewhat damaged. In front there is a nuchal scute 30 mm. from side to side and 16 mm. fore and aft. On the right side there are 2 small marginals, each about 15 mm. long. On the left side there is 1, perhaps 2, corresponding marginals. Then follows, on each side, a marginal about 44 mm. long, succeeded by several others of about the same or greater length. Further behind they shorten gradually, and the last one is very small. The first long marginal has a height of 20 mm. at its middle; the majority of them have a height of about 38 mm. Further behind the height is less.

The sulcus running along the midline of the plastron pursues a very irregular course, and the same is true of some of the others. That behind the gulars runs from the midline outward and backward for half its length, thence forward and outward. That defining the intergulars does not, at the midline, quite reach the one behind the gulars. The pectorals are about 87 mm. wide at the midline; the abdominals about 35 mm.

The sulcus between the femorals and the anals is extremely irregular. The right femoral at the midline is 62 mm. wide, the left, 78 mm. wide. There are four inframarginal scutes. The first, or axillary, is 58 mm. long and 40 mm. wide; the second has the form of a trapezium, with outer and hinder borders each about 40 mm.; the third is four-sided, 50 mm. long, 60 mm. wide. The inguinal scute is pentagonal, about 46 mm. long and broad.

A second specimen belonging apparently to this species, No. 5957 of the American Museum, was collected in the Bridger beds in 1903. It has the first vertebral scute symmetrical, 43 mm. wide in front, 65 mm. wide posteriorly. There is on each side of it a triangular supernumerary costal scute.

From *B. arenosa* the present species differs in displaying with considerable distinctness the sutures between the various bones. In no specimens of *B. arenosa* that have hitherto been collected have the sutures of the carapace been observed. It is unlikely that this disappearance of the sutures is due to greater age of the specimens of *B. arenosa*. Furthermore, the carapace of *B. arenosa* has a quite elaborate sculpturing along the middle of the back. Of this *B. clara* shows only the merest suggestions. The rear of *B. clara* is scallopt, but the cuts are much shallower than in the other species. The vertebral scutes of *B. clara* are narrower than those of *B. arenosa*. However, the most striking differences between *B. clara* and the two species above mentioned are found in the shape of the shell. The outline of *B. clara* is oval. The widest part is across the middle of the length and from this the border curves gracefully toward the front and rear. In *B. arenosa* the outline is somewhat quadrate. The sides are approximately parallel as far back as the rear of the plastron; then the border turns abruptly toward the midline.

Baëna riparia sp. nov.

Plates 17, 18; plate 19, figs. 1–3; text-figs. 59–66.

Baëna arenosa, Cope, Vert. Tert. Form. West, 1884, p. 148, plate xvii, figs. 1, 2 (not of Leidy).

Baëna riparia has as its type a fine shell and skeleton, a prize of the American Museum expedition of 1903 into the Bridger deposits of southwestern Wyoming. It was found at the Grizzly Buttes, about 15 miles southeast of Fort Bridger. The beds belong to those designated as B. The specimen is in the American Museum of Natural History and has the number 5977.

The carapace (plate 17; text-fig. 59) of this specimen is slightly crusht on the left side and the hindermost peripherals are mostly gone; otherwise the shell is complete. The carapace is especially valuable because the bones are not co-ossified, and practically all the elements may be determined. It has an axial length of about 315 mm., a slight dislocation of the bones of the rear making the estimate inexact. The width is 260 mm. From the middle of the length the width decreases gradually to the somewhat projecting front. The rear has a wide but shallow sinus over the tail. In fig. 59 the outline of the rear behind the eighth peripheral to near the pygal is somewhat conjectural, but must be close to the real condition. Along the middle of the back there runs a distinct channel which extends out beyond the neural bones. Along the middle of this there is seen a narrow ridge, on each side of which

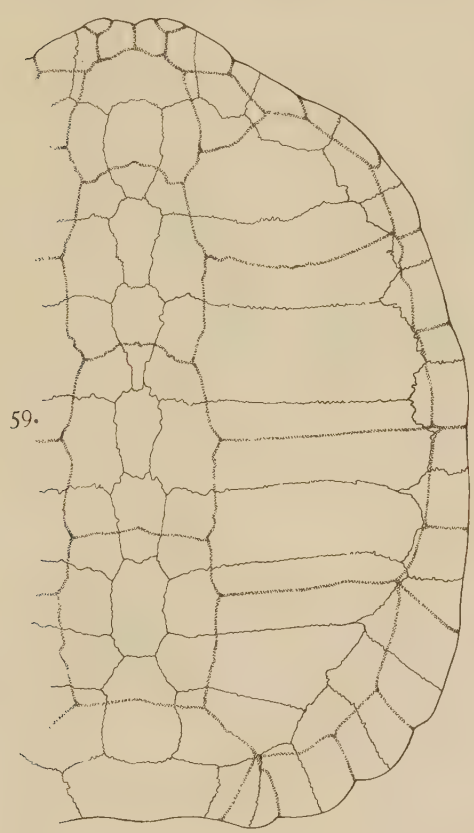
is a groove. From a point a little behind the center of each vertebral scute a few folds radiate to the ends and angles of the scutal areas. Outside of these areas the surface of the shell is somewhat uneven.

The anterior neurals are widest in front, very narrow behind. The three or four posterior are wider. The sutures are somewhat irregular. Only 7 neurals can be determined. The seventh is larger than the others and corresponds to the seventh and eighth costal plates; but no suture can be seen crossing it.

Vertebral.	Length.	Width.
1	46	48
2	72	56
3	73	57
4	68	61
5	50±	90±

The nuchal bone is slightly broader than long, 46 mm. by 35 mm. The pygal, somewhat damaged, is broader than long. The peripherals do not differ greatly in height, this being about 27 mm. There were apparently 12 of these bones on each side.

The sulci are distinctly impressed, but narrow. The nuchal scute is distinctly divided into a right and a left. At each side of it is a minute triangular first marginal. The second marginal is 33 mm. long on the free border; the third, 39 mm.; the eighth, 38 mm. The dimensions of the vertebral scutes are shown in the table.



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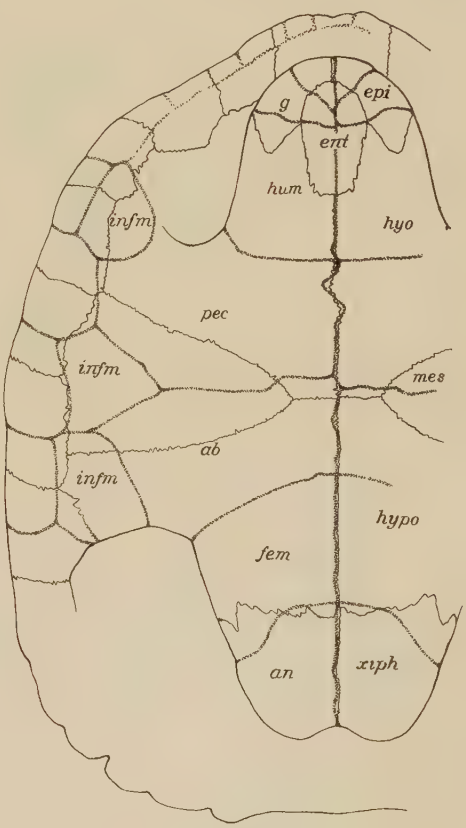


60.

FIGS. 59 AND 60.—*Baëna riparia*. Type. ×⅓.

59. Carapace, showing bones and scute areas.
60. Plastron. *ab*, abdominal scute; *an*, anal scute; *ent*, entroplastron; *epi*, epiplastron; *fem*, femoral scute; *g*, gular scute; *hum*, humeral scute; *hyo*, hyoplastron; *hypo*, hypoplastron; *infm*, inframarginal scutes; *mes*, mesoplastron; *pec*, pectoral scute; *xiph*, xiphiplastron.

There are on each side 5 costal scutes, a small supernumerary one being situated on each side of the first vertebral. Whether there are 13 or 14 marginals is uncertain. There is no supracaudal scute occupying the midline over the tail.

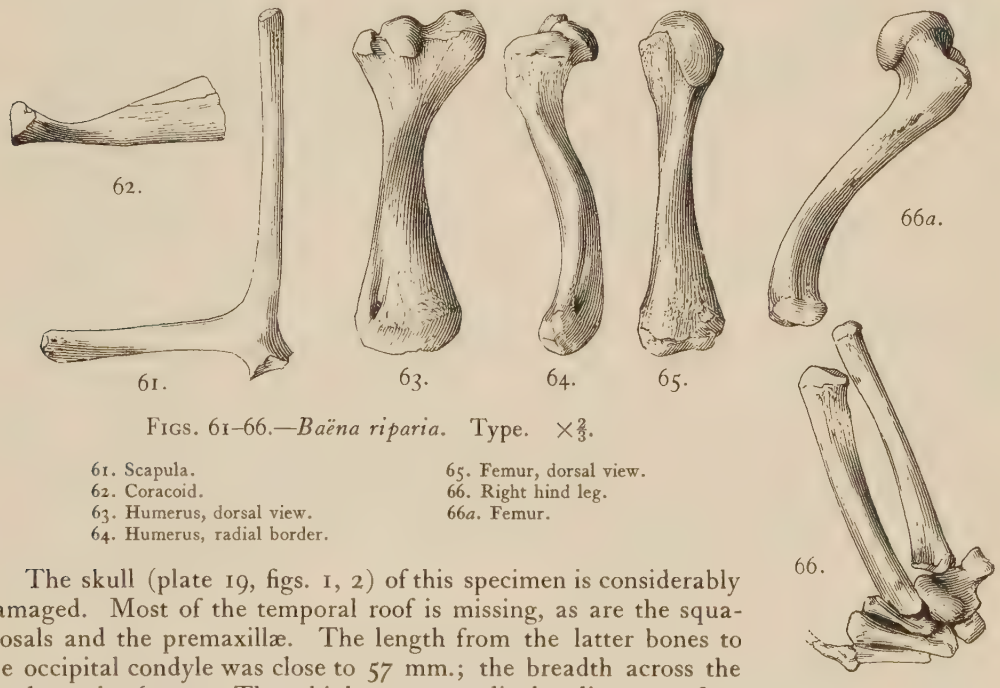
The plastron (plate 18; text-fig. 60) is 262 mm. long on the midline. Its width is close to 200 mm. As in the other species of the genus, it sends upward strong axillary and inguinal buttresses. The former rise to within 25 mm. of the first dorsal vertebra. They are joined

by the ribs of the vertebra mentioned. These buttresses extend inward from the sides of the shell, forming partitions whose inner borders are distant from each other 85 mm. The upper ends of the inguinal buttresses rise high against the contiguous borders of the fifth and sixth costal plates. Between the axillary and the inguinal buttresses of each side there is a deep sternal chamber.

The anterior lobe is 70 mm. long, 90 mm. wide at the base, and 64 mm. at the gulo-humeral sulci. It contracts gradually to these sulci, then sweeps round to the midline. The free border is obtuse and the greater part of the lobe is 10 mm. thick. The entoplastron is long and narrow, its length being 45 mm., its width 26 mm. The mesoplastra fail by about 16 mm. of reaching the midline. Laterally they expand to a width of 64 mm. The bridges are 116 mm. wide—62 per cent. of the length of that part of the plastron behind the axillary notches.

The hinder lobe is 78 mm. long, 114 mm. wide at the base, and 80 mm. at the femoro-anal sulci. The hinder border is slightly notcht. The free borders are subacute. At the inguinal notch the thickness of the bone is 18 mm., but backward it thins to about 4 mm.

The intergulars and the gulars both overlap the entoplastron. On each bridge there are 3 inframarginals, an axillary, another at the end of the pectoro-abdominal sulcus, and an inguinal. The pectoral scute comes into contact with the sixth marginal.



FIGS. 61–66.—*Baëna riparia*. Type. $\times\frac{2}{3}$.

61. Scapula.
62. Coracoid.
63. Humerus, dorsal view.
64. Humerus, radial border.
65. Femur, dorsal view.
66. Right hind leg.
66*a*. Femur.

The skull (plate 19, figs. 1, 2) of this specimen is considerably damaged. Most of the temporal roof is missing, as are the squamosals and the premaxillæ. The length from the latter bones to the occipital condyle was close to 57 mm.; the breadth across the quadrates is 56 mm. The orbit has a perpendicular diameter of 17 mm., a horizontal diameter of 15 mm., being somewhat larger than the orbit of *B. sima*, which had a larger skull. The interorbital space is 18.5 mm. wide. The nasal opening is 17 mm. wide. The narrowest part of the pterygoids is 13 mm. wide. On the inner border of the triturating surface of each maxilla there is a sharp ridge, as in *B. sima*.

The lower jaw (plate 19, fig. 3) of this species differs greatly from that of *B. sima*, being of much lighter construction and having a shorter symphysis. The distance from the tip of the jaw to the middle of a line joining the front of one articulatory surface for the quadrate with that of the other is 40 mm., the same as in the type of *B. sima*. The distance from the outside of one of the articulatory surfaces to the other is 50 mm., much less than in *B. sima*. The height of the middle of a ramus is 10 mm., the thickness 7 mm., the width of the gutter-like triturating surface 4 mm. The length of the lower side of the symphysis is 15 mm. Of the sutures of the upper surface of the skull the median, running between the nasals, prefrontals, frontals, and parietals, and the transverse which separates the parietals from the frontals, are determinable.

The course of the parieto-frontal suture is different from that of *Chisternon hebraicum*, since mesially it is placed further forward and runs outward and somewhat backward to the orbit. The upper surface of the skull appears to have been covered with horny scutes.

All of the cervical vertebræ are present, except the first. The whole series had a length of close to 100 mm., not quite one-third the length of the carapace. All have transverse processes. All have a sharp crest on the lower side of the centrum. These crests are so deep that they would have interfered greatly with any considerable flexure of the neck in a perpendicular plane. The second centrum is flat anteriorly, very concave posteriorly. The third is moderately convex in front, deeply concave behind. The fourth has the anterior end concave in the center, but the concavity is surrounded by a broad convex wall. The hinder end is shallowly concave. The fifth is rather deeply concave in front, flat behind. From the outside of one of the postzygapophyses to that of the other of the vertebra is 13 mm. The centrum of the sixth cervical is concave in front. The form of the hinder end can not be observed. The front of the seventh is concave, the hinder end flat. The eighth is concave in front; the hinder end is quite convex, but small. The first dorsal has a large concavity to receive the convex surface of the eighth cervical. This concavity looks directly forward, as in the Pleurodira, not downward as in the Cryptodira. This is another indication that the head and neck were not retracted within the shell. In the hindermost of the cervicals the zygapophyses stand high above the centra. Furthermore, the ends of the centra, especially when they are flat or convex, are considerably higher than wide. Both these conditions would be unfavorable to the flexure of the neck in a perpendicular plane. The postzygapophyses of the last cervical and the prezygapophyses of the first dorsal are short, not long and curved like those of the Cryptodira. On the other hand, the lateral motion of the neck could hardly have been so free as in the Pleurodira; and there was no projecting roof of the carapace under which the head could be concealed. We must conclude that these turtles could protect their heads hardly more than the sea-turtles.

The ascending portion of the scapula (fig. 61) is long and slender; as is also the precoracoid process. The coracoids (fig. 62) are somewhat damaged; but it is evident that the median end was not greatly expanded, not so much as in some Emydidæ. The humerus (figs. 63, 64) is 67 mm. long. The shaft is little bent. The distance from the outside of the radial process to the outside of the ulnar is 27 mm. The breadth of the distal end is 21 mm. The ectepicondylar foramen is situated 9 mm. above the condyle. The humerus is slightly longer in proportion to the length of the carapace than in *Graptemys*, but not so long as in *Chelydra*. The ulnar process does not extend so far above the head as in *Chelydra*. The remainder of the fore limb is missing.

The pelvis is badly crusht, but there appear to be no striking differences between it and that of *Chisternon hebraicum* (figs. 85, 86). The ossified prepubic process is long, and it resembles that of the species just mentioned. The femur (figs. 65, 66) is 68 mm. long and moderately bent. In proportion to the length of the carapace the femur is shorter than that of *Graptemys* and still shorter than that of *Chelydra*. The tibia and the fibula (fig. 66) are each 53 mm. long. The tarsal bones and some of the metatarsals are preserved. The second metatarsal is 21.5 mm. long. This appears to indicate a rather long foot.

The tail was long. Eleven of the vertebræ are preserved, having a length of 143 mm.; and there were evidently several more. So far as determinable, they were convexo-concave. All probably bore chevron bones. Some of the anterior caudals have, in the position of the neural spine, a rounded boss, as if for the support of a distinct bone, such as occurs on some of the caudals of *Chelydra*.

The specimen figured and described by Cope (Vert. Tert. Form. West., p. 148, pl. xvii, figs. 1, 2) as *Baëna arenosa* is now in the American Museum of Natural History and has the catalog number 1112. Cope's figures are one-fourth the size of nature and are inverted. His measurements are in some cases erroneous. The carapace is 320 mm. long, instead of 450 mm. The carapace is somewhat crusht and its transverse diameter was nearer 260 mm. than 240 mm. The length of the plastron is 290 mm. The anterior lobe is 82 mm. long; the posterior lobe 87 mm. The width of the base of the anterior lobe is 102 mm.; that of the base of the posterior lobe, 116 mm. The width of the anterior at the gulo-humeral sulci is 71 mm.; that of the

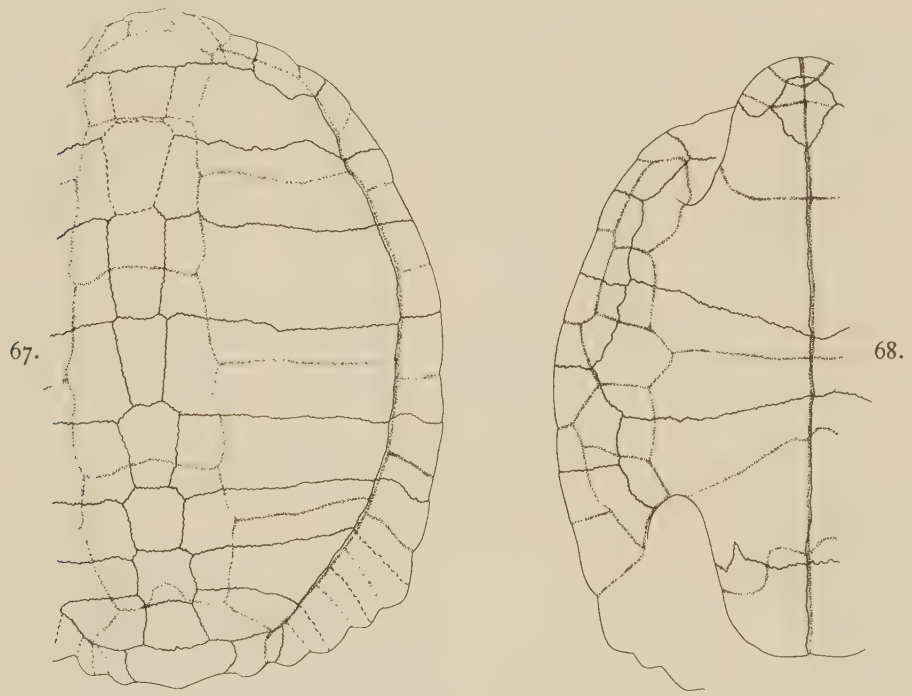
posterior at the femoro-anal sulci, 87 mm. As stated by Cope, there are three inframarginal scutes on each bridge. The present writer regards the specimens as belonging to *B. riparia*. The sutures are obliterated.

Baëna emiliæ sp. nov.

Plate 20, figs. 1, 2; text-figs. 67, 68.

The type of this species is a nearly complete shell, No. 1925, of the American Museum of Natural History and was collected in 1894, by Mr. O. A. Peterson, in the middle Uinta of Utah. Through pressure the left side has been crusht in and small portions there are missing; the edges of some of the posterior right peripherals are also broken off. On one side or the other all parts are present. The elements of the shell are not co-ossified, and we are therefore able to determine the limits of nearly all the bones entering into its composition.

The length of the carapace, measured in a straight line, is 368 mm. (plate 20, fig. 1; text-fig. 67). Its greatest width, taken at the middle of the length, is 294 mm.—almost exactly the size of the specimen described as *B. clara* and not much smaller than the specimen of *B. arenosa*, No. 1115 of the American Museum. It may therefore be conveniently compared with them.



FIGS. 67 AND 68.—*Baëna emiliæ*. Type. $\times\frac{1}{4}$. Shows bones and scute areas.

67. Carapace. 68. Plastron.

The form is much like that of *B. arenosa*, being rather wide behind, 245 mm. at the hinder end of the plastron. The posterior border is furnisht with 5 or 6 scallops, the cuts between which are of a depth intermediate between those of *B. arenosa* and *B. clara*. The upper midline is slightly channeled, except on the last vertebral, where there is a prominent carina.

The plastron (plate 20, fig. 2; text-fig. 68) resembles in general that of the other species, but the anterior and the posterior lobes are comparatively narrow. The total length is 320 mm. The anterior lobe has a length of 80 mm., a width of 110 mm. The tip is evenly rounded, the lateral border first convex, then further back concave; so that its width at the middle of its length is only 81 mm. The posterior lobe has a length of 83 mm. and a width of 122 mm. at the base. Its posterior border is nearly straight. The width of the bridge is 160 mm. The plastron comes within about 40 mm. of the end of the carapace.

This species agrees with *B. clara* in having only 4 costal scutes, instead of 5. The lateral margins of the first vertebral are parallel until they meet the marginals. Then the edge of the

vertebral runs forward and inward to the midline. The table below gives the dimensions of the vertebral scutes. These are narrower than they are in *B. arenosa* of the same size, and the third is longer than in any of the described species. There are 5 small marginal scutes lying in front of the first vertebral. Two of these, quadrilateral in form, about 26 mm. long and 20 mm. wide, occupy respectively the right and left thirds of the front border of that vertebral. A pentagonal scute 25 mm. from side to side occupies the middle third. It measures 15 mm. fore and aft; and its narrowed front scarcely reaches the margin of the shell, since two other small scutes come in front of it, one on each side. No sulcus is seen along the midline.

Vertebral.	Length.	Width.
1	55	68
2	80	63
3	92	75
4	70	78
5	70	98

The lateral marginals of *B. emiliæ* are higher than they are in either *B. arenosa* or *B. clara*. The upper border of the one below the anterior angle of the third costal scute stands about 50 mm. above the lower edge of the shell. In the specimen of *B. arenosa*, No. 1115, larger than the shell being described, the corresponding marginal hardly reaches 40 mm. The upper borders of the marginals of *B. emiliæ* appear to follow closely the sutures between the peripheral bones and the costal plates.

There appear to be 13 marginals on each side, including the minute anterior one.

The epidermal sulci of the carapace are deeply imprest; those of the plastron are rather obscure. The intergulars reach about two-thirds the distance to the humero-gular sulcus. There is a row of 5 inframarginals on each side. As to the other plastral scutes, it is not observed that they are especially different from those of *B. arenosa*.

It is possible to trace the sutures between all the bones of the shell, except those surrounding a few of the anterior neurals and some of the posterior peripherals; but even these may be located approximately.

It will be observed that the nuchal does not have the great antero-posterior extent that it does in the recent Pleurodira. The neurals are in general elongated hexagonal, with the broad end forward. The first and second measure together 83 mm., and the front one is probably a little the shorter. Of their width one can not be certain. The third is 55 mm. long, and apparently 30 mm. wide; the fourth, 43 mm. long, 27 mm. wide; the fifth, 43 mm. long, 31 mm. wide; the sixth, 35 mm. long, 32 mm. wide; the seventh, 30 mm. long, and the same in width; the eighth, 30 mm. long, and 34 mm. wide. Behind the last neural comes the pygal, 30 mm. long and 60 mm. wide. No suprapygal is found between the last neural and the pygal. The eighth costal plate occupies the whole lateral border of the eighth neural and, in addition, the postero-lateral portion of the seventh neural.

The nuchal bone has a fore-and-aft extent of 37 mm. Its width from side to side is about 50 mm. in front and about 85 mm. behind.

There are almost certainly 12 peripherals on each side. The most anterior sutures are easily distinguisht; but, for various reasons, not the posterior ones. Over the bridges the sutures between the peripherals are continuous with the sutures between the costal bones; posteriorly, there is not this correspondence. The sutures are not traceable, but there is undoubtedly one between each two epidermal sulci.

On the plastron all the sutures are easily distinguisht. The total length of the plastron is 320 mm. The epiplastra meet in the midline by a suture 13 mm. long; the length of each bone is 42 mm. The entoplastron resembles that of *B. arenosa*, as figured by Leidy (Cont. Ext. Fauna W. Terr., pl. xv, figs. 4, 5). Its length is 40 mm.; its breadth 34 mm. The suture between the hyoplastra is 96 mm. long. The mesoplastra meet in the midline for a space of 33 mm. At their outer ends they are 75 mm. wide. The suture between the hypoplastra is 87 mm. long. The xiphiplastral suture is 50 mm. long, and each, measured at its anterior end, is 50 mm. wide. The anterior and posterior buttresses of the plastron are like those of *B. arenosa*.

The intergulars measure on the midline 18 mm.; the gulars, 9 mm.; the humerals, 51 mm.; the pectorals, 84 mm.; the abdominals, 42 mm.; the femorals, 64 mm.; the anals, 54 mm. On the bridge are 5 inframarginals.

In the middle line above there are some longitudinal ridges and grooves and some irregular elevations, which are rudiments or vestiges of an ornamentation similar to that of *B. arenosa*.

This species differs from *B. arenosa* in the form of the anterior vertebral scute and in having no accessory lateral scute. In these respects it agrees with *B. clara*. From the latter it differs in having the shell broader behind, a wider and more deeply scallopt postero-lateral border, higher lateral marginal scutes, a different arrangement of the most anterior marginal scutes, and narrower plastral lobes. The bridge of the plastron is also wider. It measures 160 mm., while that of the type of *B. clara* is only 150 mm. The bridge of *B. arenosa*, No. 1115, a larger shell, also measures only 150 mm. On the under side of the postero-lateral border of the shell, at the fifth scallop, the distance from the line where the soft skin of the animal began to the outer edge of the shell is 40 mm.; in *B. clara* this space is only 33 mm.

There is in the American Museum's collection a second specimen of this species from the same level. It is somewhat smaller, with a total length of 323 mm., and is less perfect than the one which has furnisht the above description. Nevertheless, the principal characters distinguishing the species from the others are exhibited. Altho smaller, the sutures have almost wholly disappeared, so that it furnishes no aid in tracing these.

In the collection of Princeton University there is a somewhat damaged shell which is referred to this species. The catalog number is 11263. It was collected by Mr. J. B. Hatcher, in 1895, in the Uinta Eocene, at Kennedy's Hole, Utah. The beds contained remains of *Dolichorhinus cornutus*.

Genus EUBAËNA nov.

Skull resembling that of *Baëna*, but with the temporal region less extensively rooft over, the squamosals not coming into contact with the parietals. Jugals excluded from the rims of the orbits. Triturating surfaces of the maxillæ transversely broad and concave. Choanæ opening between the orbits, and at nearly one-third the distance from the snout to the occipital condyle. Shell unknown.

Type : *Eubaëna cephalica* Hay.

Eubaëna cephalica Hay.

Plate 19, fig. 4; plate 21, figs. 1, 2.

Baëna cephalica, Hay, Amer. Jour. Sci. (4), xviii, 1904, p. 263, plate xii, figs. 1–3.

The name *Eubaëna cephalica* is given to a fine skull which is in Yale University Museum. This skull, which lacks only the lower jaw, was collected in the Laramie deposits of Converse County, Wyoming, by Professor J. B. Hatcher, then employed by Professor O. C. Marsh. The specimen bears Professor Marsh's receipt number 2110.

In general form the skull is broad behind, rather flat above, and with pointed snout. The length from the snout to the occipital condyle is 67 mm.; to the end of the supraoccipital spine, 74 mm. The greatest breadth, just in front of the tympanic chamber, is 65 mm. From these chambers the width diminishes to the snout. The flat upper surface of the skull descends each way to the perpendicular sides. The sides of the face about the orbits look upward and outward, as well as forward. The tympanic opening is nearly circular, 19 mm. in its perpendicular, 15 mm. in its horizontal axis. The orbit is circular and small, its diameter being 14 mm. The interorbital space is 25 mm. wide. The nasal opening, as seen from in front, is somewhat heart-shaped, and is directed above and forward. From the orbit to the tympanic opening is 24 mm.; from the nares to the orbit is 10 mm.

The temporal region is rooft over, but not so extensively as in species of *Baëna* from the Bridger beds. On each side of the supraoccipital this roof is excavated as far as a line joining the anterior borders of the tympanic chambers. From the orbit to the bottom of the excavation is 22 mm. The hinder end of the postfrontal is interposed between the parietal and the squamosal.

In general, the sutures of the skull are very distinct, but no trace has been found of those between the frontals and the parietals. There are distinct nasals, and these and the prefrontals resemble closely the same bones in the Bridger species of Baënidæ. The prefrontal of each side joins the postfrontal, so that the area of the frontal is excluded from the border of the orbit. The sagittal suture extends from the prefrontals to the supraoccipital spine, a distance of

42 mm. The postfrontal is large, having a length of 32 mm., being in contact by its lower border with the maxilla, the jugal, and the quadratojugal; and by its posterior border with the squamosal.

The jugal is small, being only 8 mm. in length and 15 mm. in heigth. The squamosal forms the hinder border of the tympanic opening. Superiorly it has a thin crest, a relic of the former backward extension of the temporal roof. The tympanic chamber extends backward into this bone. The lower border of the zygomatic bar is considerably excavated. Seen from the side the maxilla is convex on its lower border. From this border the bone rises 11 mm. to the orbit. The premaxillæ are distinct from the maxillæ and from each other. At the symphysis they are only 3 mm. high, but at the union with the maxillæ, 10 mm. high. As in the Bridger species of *Baëna* there are distinct lacrimal bones. The lower border of each comes into contact with the vomer. The jugals are excluded from the rims of the orbits (Plate 19, fig. 4).

As seen from below, the maxilla has a broad masticatory surface, its width being 14 mm. from its inner border to the cutting-edge. The inner border of this surface is furnisht by the palatine bone. The latter forms the whole of the outer border of the choana. The masticatory surface does not extend forward on the premaxilla. In front of the choanæ there is a deep groove, which in front expands on the lower surface of the premaxillæ. There are postpalatine foramina (Plate 21, fig. 2).

The pterygoids come into short contact with the maxillæ. They have distinct ectopterygoid processes. Where the hinder part of the palate is constricted it is 18 mm. wide. The pterygoids extend backward to the hinder border of the pedicel of the quadrates, thus separating the latter widely from the basioccipital and basisphenoid. There is a considerable groove between the quadrate on each side and the median bones of the skull. The pterygoids join in the midline for a considerable distance in front of the basisphenoid. There is on each side of the latter bone, about the middle of its length, a venous foramen.

The pedicels of the quadrates are short. The surface for articulation with the mandible is deeply concave from side to side, nearly plane from front to back.

A pair of epidermal scutes appears to have occupied the space between the anterior halves of the orbits. Behind each of these and bounding the hinder half of the orbit was a smaller scute. A very large scute, or more probably a pair of them, occupied the area of the frontal bones and overlapt behind this on the parietals. The hinder half of this scute, or these scutes, if two, was separated by two median scutes. The more anterior of these last was circular; the more posterior was broadened backward and lay on the whole or part of the supraoccipital processes of the parietals.

Eubaëna latifrons sp. nov.

Figs. 69, 70.

The specimen on which the present species is based was found by Mr. Barnum Brown, of the American Museum of Natural History, in Laramie deposits, on Seven Mile Creek, Wyoming, about 40 miles northwest of Edgemont, South Dakota. It has the catalog number 6139. The specimen consists of the skull, without the lower jaw. This skull is crusht downward somewhat, and the right maxilla is forced inward partly over the triturating surface of that side. The left maxilla is missing. A part of the temporal roof is broken away and most of the supraoccipital spine is gone.

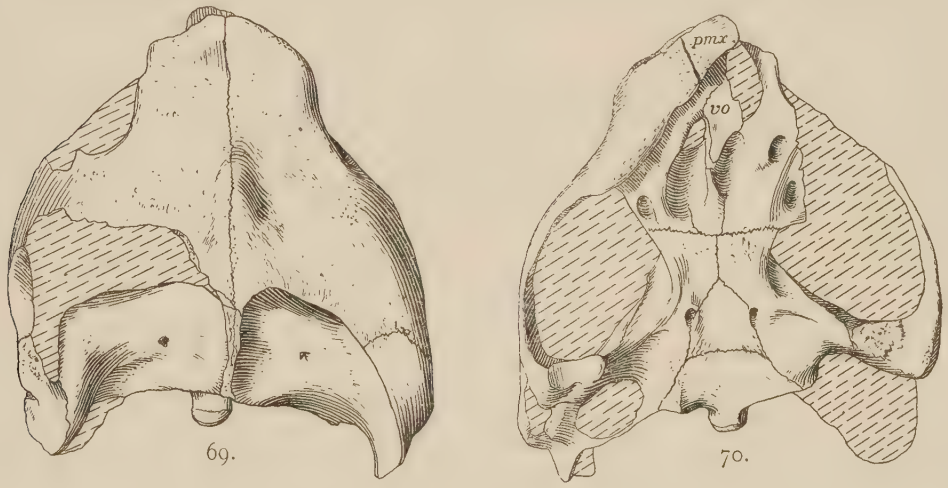
It is not impossible that the shell of this species has already been described as one of the Laramie species of *Baëna;* but this can not be determined until the skull and the shell have been found together. The skull resembles that of *E. cephalica;* but a number of differences exist, which will be mentioned as the description proceeds.

How far the premaxillæ extended beyond the front of the nasal bones can not be determined exactly; but the distance appears to have been less than in *E. cephalica.* It may be assumed to have been about 5 mm. The length of the skull, from the front of the nasals to the occipital condyle, is 72 mm. The width from one quadratojugal to the other is 73 mm. Evidently the orbits looked upward less than in *E. cephalica*, for the width of the interorbital space is 32 mm.; in *E. cephalica*, only 25 mm. The horizontal diameter of the orbit is 17 mm., being thus more than in the species with which it is compared. The tympanic chamber, too,

is larger than that of the other species, the horizontal diameter being 24 mm. The perpendicular diameter is now only 16 mm., but this is due, no doubt, to crushing. From the orbit to the tympanic cavity is 22 mm.

The roofing of the temporal region resembles that of *E. cephalica*. Few of the sutures of the upper side of the skull can be traced with certainty; but it is evident that the parietal union with the squamosal had been severed by the excavation in the hinder border of the roof. There are reasons for believing that the parietals were each 15 mm. wide posteriorly. If the prefronto-nasal suture is where it seems to be, the nasals were unusually large, running along the midline 8 mm. The parieto-frontal and the fronto-prefrontal sutures can not be determined with certainty. The nasal opening has now a width of 23 mm. One premaxilla is present and has the height and the width each 9 mm. The maxilla, below the orbit, is 11 mm. wide, being thus narrower than that of *E. cephalica*.

The upper surface of the skull is rough with narrow ridges, separated by sharp furrows. This interferes with the tracing of the sutures; for the latter do not appear to be really absent. Occasional narrow grooves indicate that the skull was covered with horny plates; but these can not be mapt.



FIGS. 69 AND 70.—*Eubaëna latifrons*. Skull of type. $\times\frac{3}{4}$.

69. Skull seen from above. 70. Skull seen from below. *pmx*, premaxilla; *vo*, vomer.

The base of the skull and the roof of the mouth resemble in general the same regions of *E. cephalica*. At the pterygoid constriction the width is only 16 mm. The postpalatine foramina are placed 24 mm. apart; whereas, in *E. cephalica* they are only 18 mm. apart. The maxillary triturating surfaces appear not to have been so wide as those of *E. cephalica*. As in the latter species, they are bounded on the inner margin by a rough ridge.

Genus CHISTERNON Leidy.

Related closely to *Baëna*, but having 2 bones, an anterior and a posterior, occupying the region of the nuchal of *Baëna*. Normally 2 scutes occupying the area corresponding to the first vertebral of *Baëna*. No supramarginals. Maxilla with a nearly plane triturating surface.

Type, *Baëna undata* Leidy.

The genus was based by Dr. Leidy on the presence of the mesoplastra, but these were afterwards found to be present in *Baëna arenosa* also. The existence of the two bones in the region of the nuchal, with the absence of supramarginals, will characterize the genus.

Two specimens of *C. undatum* and one belonging to Cope's *Baëna hebraica* in the American Museum of Natural History show unmistakably the two bones mentioned as occurring in the region of the anterior neural.

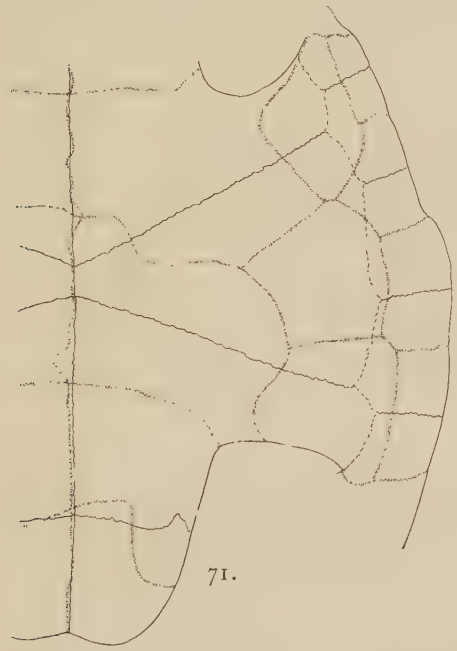
Remarks on the significance of the preneural and the supernumerary scutes will be found on page 57.

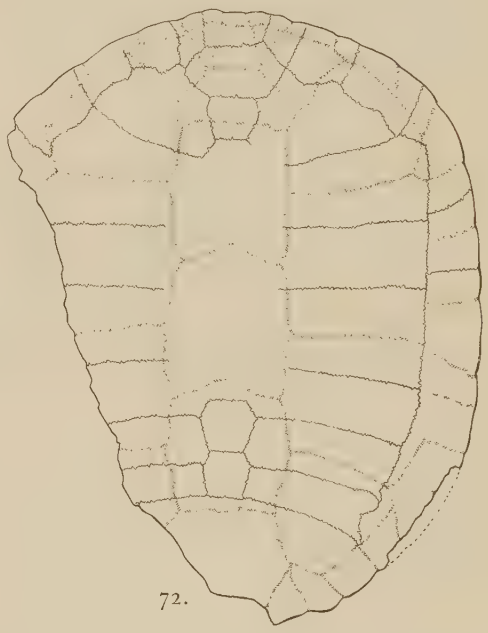
Chisternon undatum Leidy.

Plate 22; text-figs. 71–75.

Baëna undata, LEIDY, Proc. Acad. Nat. Sci. Phila. 1871, p. 228; U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 369.—COPE, 6th Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 622; Vert. Tert. Form. West, 1884, p. 147, plate xix, figs. 3–5.—OSBORN, SCOTT, and SPIER, Contrib. Mus. Geol. and Arch. Princeton Univ., No. 1, 1878, p. 96.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.
Chisternon undatum, LEIDY, Proc. Acad. Nat. Sci. Phila. 1872, p. 162; Contrib. Ext. Fauna West. Terrs. 1873, pp. 169, 341, plate xiv, figs. 1, 2.

The type of Leidy's *Chisternon undatum* is in the collection of the Academy of Natural Sciences at Philadelphia. The specimen is said to have been collected in a range of buttes a few miles from Fort Bridger. This range is probably Grizzly Buttes and the level is B. The shell belonged to a turtle whose carapace had a length of about 485 mm. The front and the rear of the shell are missing, so that Leidy could not know the structure of the bones and scutes of the front of the carapace. As stated by that author, the shell is rather high and archt, its upper surface standing above the bottom of the plastron about 7.5 inches, equal to 190 mm. The sutures may be traced by means of the band of striations that crost them, and Leidy was enabled to map correctly the bones of the plastron. The mesoplastra come to a point at the midline. The costo-marginal sulci over the bridges run about 50 mm. above the borders of the shell.





FIGS. 71 AND 72.—*Chisternon undatum*. Carapace and plastron.

71. Plastron of No. 3932 A. M. N. H. × ¼. Anterior lobe missing.
72. Carapace of No. 5959 A. M. N. H. × ⅛. Areas of some bones not mapt.

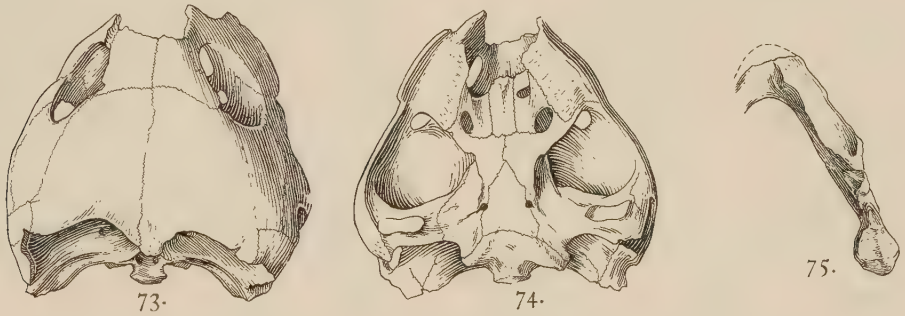
Many characters given by Cope as distinguishing this species from *C. hebraicum* are not conclusive. There is no appreciable difference in the sizes of the anterior lobes; nor do the intergular and gular scutes of *C. undatum* always start from a common point. So far as the writer has observed, the marginal scutes of *C. hebraicum* rise considerably higher above the margins of the shell over the bridges than they do in *C. undatum*. As will be shown below, there are important differences in the skulls.

In the American Museum there are 4 large shells which are regarded as belonging to this species. In none of these are the boundaries of all the bones to be made out, altho in some of them many sutures may be traced.

No. 3932 (plate 22; text-fig. 71) was collected in 1893 in the Bridger beds of Wyoming, but the exact locality and level are unknown. The length along the midline is 433 mm.; the

greatest width, 387 mm. The outlines of many of the neural bones are determinable. On the front of the carapace, however, the indications are obscure. The vertebral scutes are a little longer than wide. The scutes on the front of the carapace are unsymmetrical. On the left side there is a supernumerary costal, but not on the right side. The anterior vertebral is not transversely divided as it is in the other specimens. Over the bridges the marginal scutes are not more than 45 mm. high. The anterior lobe of the plastron is missing. On the left bridge there are only three inframarginal scutes.

No. 5974 was collected in 1903 near the mouth of Cottonwood Creek, in the level called B^2. It has a length of 490 mm. along the midline, and a maximum width of 425 mm. The rear of the carapace is scallopt. Most of the sutures are indistinct, but the small nuchal and the large preneural are plainly separated. The former is 38 mm. long and 46 mm. wide; the latter, 45 mm. long and 72 mm. wide. The first vertebral scute is transversely divided, so that there are present really 6 vertebrals. On each side of the two anterior ones is a supernumerary costal, and an extra scute has been cut off from the first vertebral and the right supernumerary costal. The marginals over the bridges appear not to run more than 50 mm. above the borders of the shell. The plastron is 440 mm. long. The entoplastron has a length of 80 mm. and a width of about 45 mm. The mesoplastral sutures are not wholly distinct, but these bones appear to have come to a point at the midline. The anterior lobe is 120 mm. long; 150 mm. wide at the base; 93 mm. wide at the gulo-humeral sulci. The bridge is 205 mm. wide. The hinder lobe has a length of 125 mm.; a width of 155 mm. at the base, 122 mm. at the femoro-anal sulci. On each bridge are 4 inframarginal scutes. The gulars meet each other for a distance of 13 mm. at the midline.



FIGS. 73–75.—*Chisternon undatum*. Skull of No. 5962 A. M. N. H. $\times\frac{1}{2}$.

73. Skull seen from above. 74. Skull seen from below. 75. Right half and tip of lower jaw.

No. 5959 (fig. 72) was obtained at Grizzly Buttes, Wyoming, in 1903. The axial length of the carapace is 455 mm.; its width, 400 mm. As in No. 3932, there is a broad depression along the midline of the carapace. There is a distinct nuchal bone, followed by a larger preneural. There are 6 vertebral scutes, whose dimensions are given in the accompanying table.

Vertebral.	Length.	Width.
1	35	36
2	44	92
3	95	95
4	105	97
5	105	96
6	69	105

There is a small supernumerary costal scute on each side of the first vertebral scute and another on each side of the second (fig. 72). The border of the shell over the right bridge is crusht, but the costo-marginal sulci appear to have run not more than 60 mm. above the border of the shell. The entoplastron is 80 mm. long and about 48 mm. wide. On the right bridge are five inframarginals. The left bridge is missing.

No. 5962 was collected at Grizzly Buttes, in 1903. It was lying close to No. 5961, a specimen of *C. hebraicum*. The carapace is much crusht laterally and diagonally. The specimen is valuable because it furnishes the skull. The carapace was at least 460 mm. long. So far as can be determined, the costo-marginal sulci pursued their courses above the bridges at a moderate height. There are 6 vertebral scutes and a pair of supernumerary costals in front. There are traces of the suture between the nuchal and the preneural.

Most of the dimensions of the skull (figs. 73, 74) are presented on page 89. It differs from that of *C. hebraicum* especially in the broader triturating surfaces of the maxillæ and the broader

pedicels of the quadrates. There appears to have been only a rudimentary ridge on the triturating surface. The sutures between most of the bones may be traced, but those separating the frontals from the parietals have not been observed. Nasals were quite certainly present, but they are broken away. The lower jaw is present (fig. 75). The triturating surface is transversely concave and 9 mm. wide. The tip of the jaw is damaged so that the length of the symphysis can not be exactly determined; but it was not far from 15 mm.

Chisternon hebraicum Cope.

Plate 21, figs. 3, 4; plate 23, fig. 1; text-figs. 76–87.

Baëna hebraica, Cope, Palæont. Bull. No. 1, 1872, p. 463; Proc. Amer. Philos. Soc., xii, 1873, p. 463; 6th Ann. Report, U. S. Geol. Surv. Terrs., 1872 (1873), p. 62; Vert. Tert. Form. West, 1884, p. 146, plate xix, figs. 1, 2.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.
Baëna undata, Hay, Bull. Amer. Mus. Nat. Hist., xxi, 1905, p. 138, figs. 1–3.

Professor Cope's type of the present species consists of about two-thirds of the anterior portion of the carapace and the plastron. It was obtained by him in the Bridger Badlands along Cottonwood Creek, Wyoming, and hence in the level known as B. This type is now in the U. S. National Museum at Washington. It appears to be necessary to correct some of Cope's measurements. The transverse axial width is given by him as 500 mm., but it is only 420 mm. Accordingly, Cope's figures are just one-third the size of nature. Cope's estimate of the length was also 500 mm., but the writer would make it only about 425 mm. In either case the shell is about as broad as long. The length of the anterior lobe of the plastron, to a line joining the bottoms of the axillary notches, is 125 mm. Its width is 147 mm. The bridges are 162 mm. wide. The hinder lobe has a basal width of 160 mm.

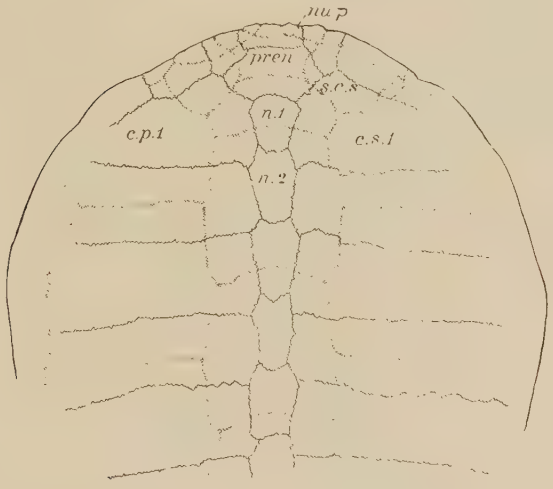


Fig. 76.—*Chisternon hebraicum*. Portion of carapace. $\times\frac{1}{6}$. No. 5961 A. M. N. H.

c. p. 1, front costal plate; *c. s.* 1, first costal scute; *n.* 1, *n.* 2, neural bones; *pren*, preneural.

As shown by Cope's figures, the nuchal and the anterior marginal scutes have small extent at right angles with the free border, and the first vertebral is transversely divided so as to make 6 vertebrals in all. The marginals over the bridges are higher than long, and the corresponding costal scutes become thereby about as high as long. There is likewise a supernumerary costal scute on each side of the first vertebral.

The shoulder-girdle is present, but has not been wholly freed from the matrix. The scapula is at least 90 mm. long from the glenoid fossa to the upper end. At its base the coracoid has a diameter of 7 mm.; at a distance of 65 mm. from the glenoid fossa the diameter is 65 mm.

No. 5961 of the American Museum is referred to this species. It was collected in 1903 by Mr. L. S. Quackenbush, a member of the museum's party. The locality is Grizzly Buttes, not far from the locality where Cope's type was collected. It was found lying in close proximity with the specimen numbered 5962 and referred to Leidy's *Chisternon undatum*. Both specimens furnisht good skulls and other skeletal parts. Figure 76 represents the carapace of No. 5961; fig. 77, the plastron. The shell, especially in the region of the distal ends of the costals, is thin and fragile and some parts were lost. The right half of the nuchal is gone, the rear of the carapace is missing.

The axial length of the carapace was close to 474 mm.; the greatest width 435 mm. It was moderately convex. The surface is nearly smooth. Along the areas of the vertebral scutes are some traces of the sculpture so conspicuous in the case of species of *Baëna*. Across some of

the intercostal sutures are a few of the grooves described by Cope. Fortunately the sutures between the bones are yet open, so that the whole structure can be observed. The most striking feature of the carapace is the presence of two bones in the region usually occupied by the nuchal, a small anterior and a large posterior. The anterior bone (fig. 76, *nu.p*), here regarded as the true nuchal, has a width of 52 mm. and a length, fore and aft, of 30 mm. The other bone, the preneural (fig. 76, *pren*), is 75 mm. wide and 38 mm. long. The first neural is pyriform, the others hexagonal, with the wider end forward.

No.	Neurals.		Vertebrals.	
	Length.	Width.	Length.	Width.
1	44	42	40	70
2	57	38	42	102
3	60	39	111	115
4	57	30	115	115
5	48	38	...	104
6	..	34	...	...

The first three peripheral bones are each 42 mm. high. Those over the bridges have a height of about 65 mm. There are 6, instead of 5, vertebral scutes, the areas usually covered by the first being transversely divided. The dimensions of the neurals and vertebrals are shown in the table.

The nuchal scute is small and was probably not divided along the midline. It is 24 mm. wide and 10 mm. fore and aft. The first marginal is small and triangular. The second has a length of 25 mm. along the free border and a height of 16 mm. The third is not so high. Those marginals over the bridge rise above the borders of the costal bones and have a height of approximately 70 mm.

A little of the hinder border of the plastron (fig. 77) is broken away, but the total length was very close to 415 mm. In general it resembles the plastron of species of *Baëna*. The length of the anterior lobe is 113 mm.; its width at the base, 160 mm.; at the outer ends of the gulo-humeral sulci, 85 mm. The entoplastron is 65 mm. long and 45 mm. wide. The symphysis of the epiplastra is only 14 mm. long. From the entoplastron the hyoepiplastral sutures run outward and backward. The bridge has a width of 180 mm. The mesoplastra join at the midline for a distance of 20 mm., the left one being somewhat the wider. They expand outward to a width of 105 mm.

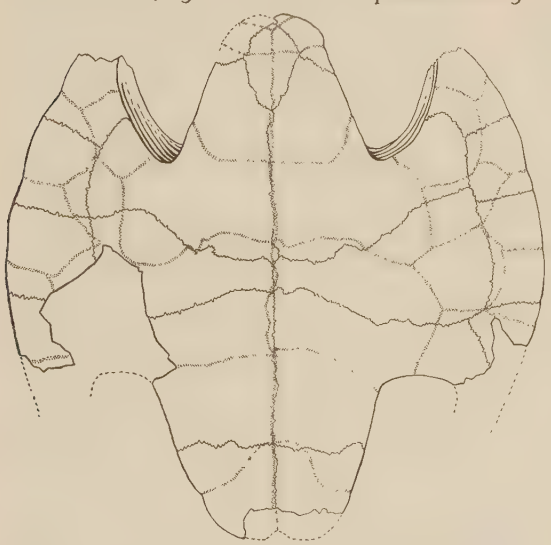


FIG. 77.—*Chisternon hebraicum*. Plastron. $\times\frac{1}{6}$. No. 5961 A. M. N. H. Shows bones and scute areas.

The length of the hinder lobe was originally about 105 mm. Its basal width is 175 mm.; at the hypoxiphiplastral suture, 145 mm.; at the femoro-anal sulci, 120 mm. The thickness of the center of the anterior lobe is 11 mm. Between the axillary buttresses, on the upper surface, runs a broad ridge which thickens the bone to 15 mm. A similar ridge crosses from one inguinal buttress to the other. From the latter buttresses a ridge runs backward near each free border of the hinder lobe, and thru these the thickness is 17 mm. The central part of the hinder lobe is concave.

The skull (plate 21, figs. 3, 4; plate 23, fig. 1; text-figs. 78–81) of this specimen is nearly complete, lacking only a part of the left maxilla, and the premaxillæ. At the time the writer publisht his figures of this skull, he had not yet discovered the differences between this specimen and that numbered 5962, described here as *Chisternon undatum*. In order to allow comparisons the measurements of the two skulls are given in the table on p. 89.

There is a difference of only 5 mm. in the lengths of the skulls. There is a difference of this same amount in the widths of the maxillæ below the orbits, a difference of 8 mm. in the widths of the skulls at the quadrates, a difference of 6.5 mm. in the distances from the orbit to the tympanic cavity.

The skull is short, broad behind, wedge-shaped in front. The temporal region is broadly rooft over and the squamosal comes into contact with the parietal.

Nasals are present. The frontals are triangular, with one apex directed to the corresponding orbit, without reaching it. The exoccipitals meet in the midline neither above nor below the occipital foramen. The occipital condyle belongs wholly to the basioccipital. On the lower side of the skull the pterygoids exclude the quadrates from contact with the basioccipital and the basisphenoid. The latter bone does not quite reach the vomer. On each side

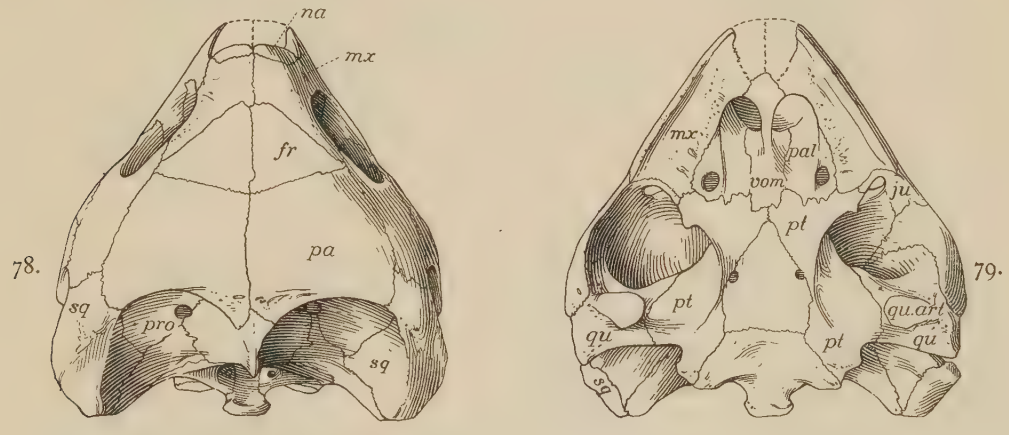
	Chisternon hebraicum, No. 5961.	*Chisternon undatum*, No. 5962.
Length from front of maxilla to occip. condyle...	67	72
Width across the quadrates.....	69	77
Diameter of tympanic cavity.....	16.5	21
Breadth of temporal roof from orbit.....	24	29
Diameter of orbit.....	20	23.5
Interorbital space.....	20	23
Breadth of maxilla below orbit.....	8	13
Width of pterygoids.....	17.5	17.5
Width of hinder end of maxilla from outside of cutting-edge to suture with palatine.....	11	15
Orbit to border of tympanic cavity.....	18.5	25
Width of pedicel of quadrates on level with palate	16	20

of the basioccipital is a foramen, doubtless for a vein, wrongly regarded formerly by the author as for the internal carotid artery.

The choanæ are placed far forward. There is no masticatory ridge on the maxilla. Just within the rim of the orbit there is a distinct suture which cuts off the lacrimal from the prefrontal.

The lower jaw (fig. 81) presents a rather broad grinding surface.

The femora of this specimen are present. The total length is 107 mm. The head is comprest. The plane passing through this head would come into contact with the tibial



FIGS. 78 AND 79.—*Chisternon hebraicum*. Skull. ×¾. No. 5961 A. M. N. H.

78. Seen from above. *fr*, frontal; *mx*, maxilla; *na*, nasal; *pa*, parietal; *pro*, prootic; *sq*, squamosal.
79. Seen from below. *ju*, jugal; *mx*, maxilla; *pal*, palatine; *pt*, pterygoid; *qu*, quadrate; *qu. art*, articulation of lower jaw; *sq*, squamosal; *vom*, vomer.

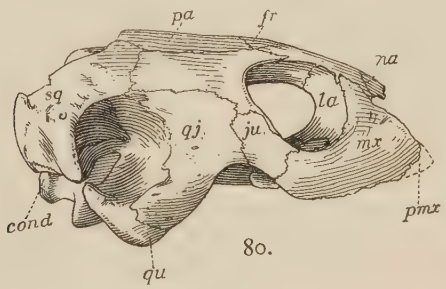
border of the distal end of the bone. In *Trachemys elegans* this plane makes an angle of perhaps 40° with the axis of the bone on the tibial side. The diameter of the shaft of the femur of the species here described is 11 mm. The width of the distal end is 31 mm.

No. 5904 of the American Museum was also found at Grizzly Buttes. It is believed to belong to the present species. It furnishes a large shell nearly complete, a portion of the skull and lower jaw, the neck, the shoulder-girdle, and the complete pelvis. The carapace has an axial length of 505 mm., and a maximum width of 470 mm. The carapace is moderately convex

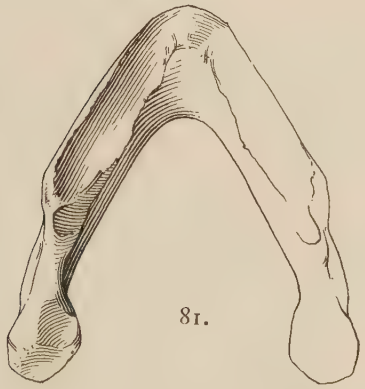
above and the bridges rise considerably above the bottom of the plastron. The outline of the carapace is somewhat pointed in front and furnisht behind with rather shallow scallops. In the midline behind is an excavation about 80 mm. wide. As in the other carapace the bones are rather thin. The specimen has the characteristics pointed out by Cope as distinguishing his *Baëna hebraica*, the presence of coarse grooves across the intercostal sutures and the high marginal scutes over the bridges. The bones are thoroly co-ossified and no certain traces can be seen of the suture between the nuchal and the preneural. The dermal sulci are mostly distinct, but even these are obscure in the front of the carapace. The vertebrals are as in No. 5961. The marginal below the front of the first costal scute, probably the fourth, has a height of about 35 mm.; two over the bridge have a height of 85 mm.

The plastron presents no novel features, its sutures and sulci being obscure.

The hinder portion of the skull is present, as well as the lower jaw. Its width behind is 90 mm. The temporal roof extended backward somewhat further than in No. 5961, but this



80.



81.

Figs. 80 and 81.—*Chisternon hebraicum*. No. 5961 A. M. N. H. Fig. 80, $\times\frac{3}{4}$. Fig. 81, $\times\frac{1}{5}$.

80. Skull from right side. *Cond*, occipital condyle; *fr*, frontal; *ju*, jugal; *la*, lacrimal; *mx*, maxilla; *na*, nasal; *pa*, parietal; *pmx*, premaxilla; *qj*, quadra-tojugal; *qu*, quadrate; *sq*, squamosal.

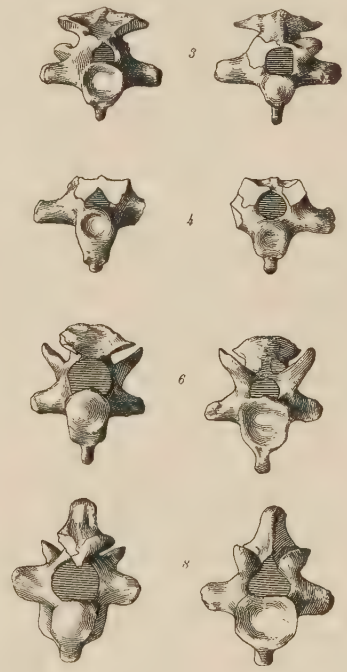


Fig. 82.—*Chisternon hebraicum*. $\times\frac{3}{5}$. No. 5904 A. M. N. H.

End views of third, fourth, sixth, and eighth cervical vertebræ. On the right side the anterior ends; on the left, the hinder ends.

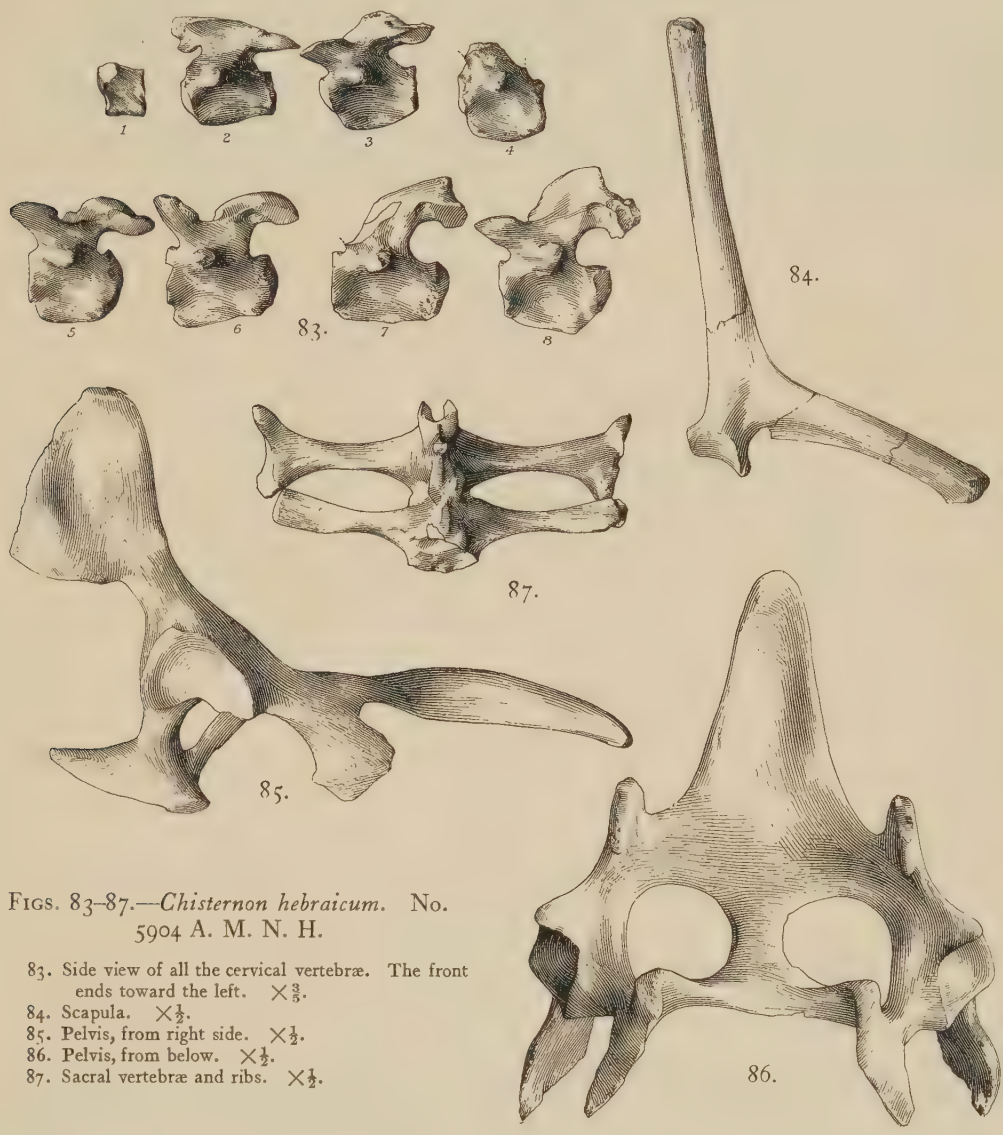
may be due to greater age. Over the brain-case the bone is 9 mm. thick. The lower jaw is nearly complete. From the tip to the middle of a line joining the hinder ends of the rami the distance is about 60 mm. The symphysis measured about 20 mm. The triturating surfaces are concave in both directions; their width, 9 mm. The coronoid process stood 23 mm. above the lower border of the bone.

The neck had a length of 165 mm., about one-half of the length of the dorsal part of the column (figs. 82, 83). The zygapophyses are high and not far removed from the midline. There is a sharp crest on the lower midline of each centrum. The second and third are convexo-concave; the fourth, biconcave; the fifth to the eighth, concavo-convex. The neural arches appear to be co-ossified with the centra. Fig. 84 represents the scapula.

The pelvis is shown in figs. 85 and 86. The ilia, the ischia, the pubes, and the epipubic process are all solidly co-ossified. The expanded upper end of the ilium has a height of 52 mm. and a width of 42 mm. The posterior articular end of the centrum of the second sacral

(fig. 87) has its upper half very little concave, while the lower half is slightly convex and uneven. The anterior articular surface of the first caudal is decidedly concave, but not so much so as is the hinder end.

On the upper surface of each xiphiplastron is a depression about 30 mm. long and half as wide. The inner borders of the two are 55 mm. apart. The tuberosities of the ischia appear not to have fitted into these depressions, for they are less than 55 mm. apart. From each of the



FIGS. 83–87.—*Chisternon hebraicum.* No. 5904 A. M. N. H.

83. Side view of all the cervical vertebræ. The front ends toward the left. $\times\frac{3}{5}$.
84. Scapula. $\times\frac{1}{2}$.
85. Pelvis, from right side. $\times\frac{1}{2}$.
86. Pelvis, from below. $\times\frac{1}{2}$.
87. Sacral vertebræ and ribs. $\times\frac{1}{2}$.

tuberosities there projects backward a long pointed process that must have extended somewhat behind the hinder border of the plastron. The lateral processes of the pubes rested on the hypoplastra at points about 25 mm. inside the free borders of the hinder lobe.

Genus BOREMYS Lambe.

Boremys, LAMBE, Ottawa Naturalist, XIX, 1906, p. 232.

Like *Baëna*, but having on each side supramarginal scutes, which alternate with the costal scutes. Nuchal bone short and wide. A preneural present.

Type: *Boremys pulchra* Lambe.

Boremys pulchra Lambe.

Figs. 88, 89.

Baëna hatcheri, LAMBE, Geol. Surv. Canada, Contrib. to Canad. Palæont., III (4 to), pt. 2, 1902, p. 43, fig. 8.
Baëna pulchra, LAMBE, Ottawa Naturalist, XIX, 1906, p. 187, plate iii, fig. 4; pl. iv.
Boremys pulchra, LAMBE, Ottawa Naturalist, XIX, 1906, p. 232.

The type of the present species belongs in the collection of the Geological Survey of Canada. It, together with at least one other specimen, was collected by Mr. Lawrence M. Lambe, of the Survey, from beds belonging to the Belly River series, equivalent to the Judith River beds. The locality is the mouth of Berry Creek, on the Red Deer River, Alberta. The type consists of the anterior half of the carapace and the complete plastron. The other specimen furnishes the anterior portion of the carapace only. Through the kindness of the discoverer of the species the writer has had the opportunity of examining it.

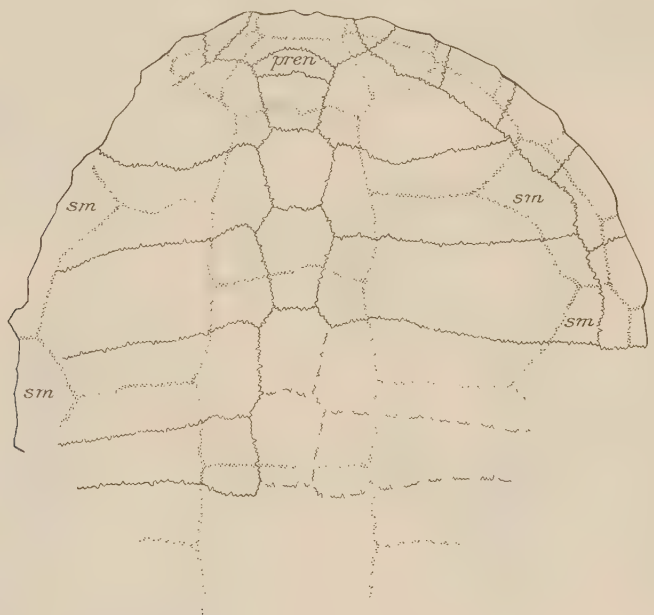


FIG. 88.—*Boremys pulchra*. Carapace of type. ×½. From Lambe's figure.

pren, preneural; *sm*, supramarginal scutes.

The specimen was originally referred to *Baëna hatcheri* for the reasons that it was not then generally accepted that the Judith River formation was distinct from the Laramie, that the specimen is somewhat crusht, that it resembles in various ways *B. hatcheri;* and for the reason finally that the presence of the supramarginals was then overlookt. The broader front of the carapace was noted and caused some hesitation. The presence of the supramarginals and the small preneural makes the separation of the species as the type of a new genus justifiable.

The type specimen was a rather small individual, having close to three-fifths the length of the type of *Baëna riparia* and a little more than one-half that of *B. hatcheri*. The carapace (fig. 88) had a length of about 195 mm. It is doubtful whether the width has been increast by the crushing to which it was subjected.

The front of the carapace is considerably broader and more rounded than that of *B. hatcheri*. The neurals, so far as preserved, appear to differ in no important respect. The first appears to be transversely divided into two parts. The anterior portion is to be regarded as a preneural, such as is seen in *Chisternon*. The shortness of the nuchal bone is remarkable. Whereas, in *B. hatcheri* and other specimens of *Baëna* which reveal the sutures, the nuchal has about the same fore-and-aft length as the first neural, in *Borëmys pulchra* the nuchal is not one-half as long as the neural. Its width is about 4 times its length.

The scutes in front of the first vertebral are more symmetrically arranged than in *Baëna hatcheri;* but in *Baëna* and possibly in *Boremys* these scutes are subject to great variation. The vertebrals are slightly longer than broad. In *B. hatcheri* they are much broader than long. There is an accessory, or supernumerary, costal scute on each side of the first vertebral. In species of *Baëna* one or both of these may be absent. The presence of large supramarginals (fig. 88, *sm*) is surprising. In *Macrochelys* there are three or four of these on each side; but these are comparable in size and position with the marginals. In *Boremys pulchra*, on the contrary, the supramarginals are as long fore and aft as are the costals and alternate with them.

The plastron (fig. 89) has a length of about 172 mm. The anterior lobe is slightly narrower than that of *B. hatcheri.* The entoplastron is long and narrow. The bridge is somewhat narrower relatively to the length of the plastron than in *B. hatcheri.* The mesoplastra join along the midline for a space of about 14 mm. The hinder lobe seems to differ little from that of the species just mentioned. The intergulars are small and do not reach back on the entoplastron, thus differing from those of *B. hatcheri.*

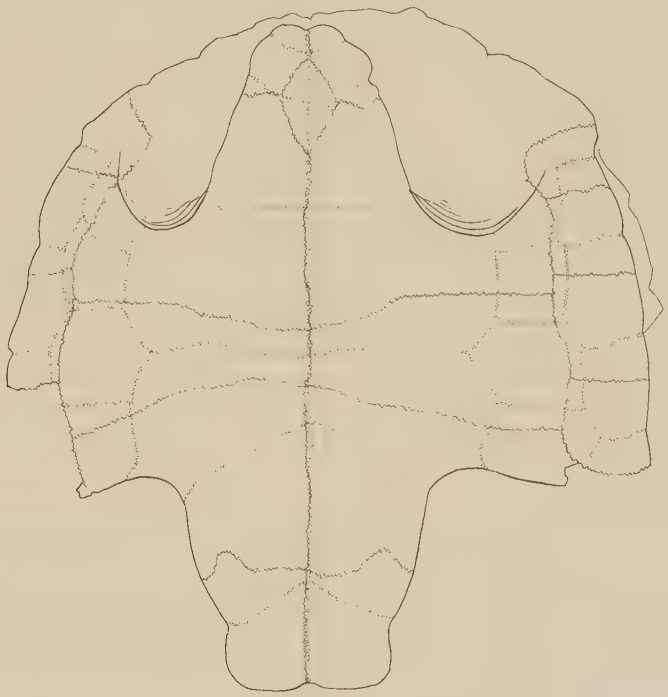


FIG. 89.—*Boremys pulchra.* Plastron of type. ×½. From Lambe's figure.

Genus NEURANKYLUS Lambe.

A genus of uncertain position and known only from a portion of the carapace of the type species. Eighth neural large, followed by an expanded suprapygal. In the type a ninth pair of costal bones. The vertebral scutes nearly twice as wide as long.

Type: *Neurankylus eximius* Lambe.

This genus is placed provisionally in the *Baënidæ*. When the last neural of *Neurankylus eximius* is compared with that of *Baëna riparia* they are seen to be very similar. The preceding neural in the latter species is elongated and appears to occupy the place of two neurals; and it is possible that the sixth and seventh neurals of Lambe's figures were consolidated. The presence of the ninth pair of costals is probably an individual variation and of no classificatory value, as suggested by the Yale specimen of *Echmatemys wyomingensis* (Leidy), which possesses ten pairs of costals. The very broad vertebral scutes indicate that the genus is distinct from *Baëna*. Mr. Lambe placed the genus provisionally among the Chelydridæ, but as no genera of this family are known from deposits older than the Tertiary and as the type has some

resemblances to the *Baënidæ*, which flourisht at that time, it seems better to refer *Neurankylus* to this family until more is known about it.

Neurankylus eximius Lambe.

Neurankylus eximius, LAMBE, Contrib. Canad. Palæont., III (4 to), 1902, p. 42, fig. 7.

The remains on which this species was based were collected by Mr. Lawrence M. Lambe in 1901, from Judith River deposits, Belly River series, on Red Deer River, Alberta. They consist of the costals of the third pair; the right fourth; the left fifth, sixth, seventh, eighth, and the supernumerary ninth; the most posterior neural; and the suprapygal. No peripheral bones were secured. The individual appears to have had a carapace 360 mm. long. The eighth neural is elongated and wider behind than in front. It articulates laterally with the

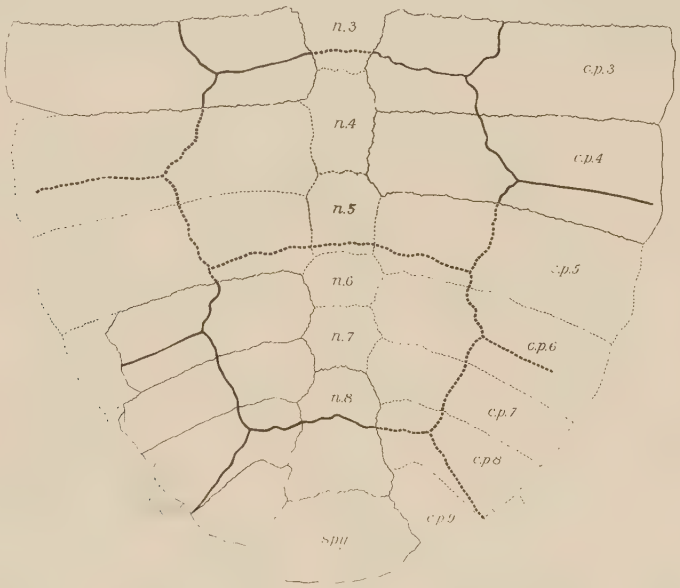


FIG. 90.—*Neurankylus eximius*. Hinder portion of carapace of type. From Lambe's figure. $\times\frac{1}{3}$.

c. p. 3, *c. p.* 4, etc., costal plates; *n.* 3, *n.* 4, etc., neural plates; *spy*, suprapygal.

costals of the seventh, eighth, and ninth pairs. The posterior neural of *Baëna riparia* articulates with the seventh and eighth pairs of costals. The suprapygal of *Neurankylus eximius* was probably followed by a pygal.

The vertebral scutes are relatively broad, the third being nearly twice as wide as long. The sides are bracket-shaped. The costo-marginal sulci evidently ran along on the peripheral bones. The costal scutes had relatively little height.

Mr. Lambe states that no very decided sculpture is shown on the surface of the bones. Striations occur adjoining and at right angles with the sutures; elsewhere, especially near the proximal ends of the costals, there is some roughness, produced by small, obscure, and irregular depressions. On two of the costals there occur some comparatively large, concentrically curved groove-like markings.

Genus THESCELUS nov.

Carapace with an enamel-like surface, which is sculptured into raised dots and lines, the latter irregular in length and direction, with intervening pits and valleys. The front of the carapace shortened and excavated in the midline; the rear somewhat pointed. The plastron like that of *Baëna*. Bridges broad, extending far forward. The buttresses feebly developt.

Type: *Thescelus insiliens* Hay.

The bridges of the members of this genus extend far forward, so that the opening for the head and fore legs is narrowed. The movements of the fore legs must have been a good deal

restricted. On the other hand, the openings for the hind legs were large. It seems probable that these turtles were accustomed to lying in the water in wait for passing victims and leaping on them and seizing them. The hinder limbs were probably large and strong.

> Quære alium, tua quem moveant miracula, dixit
> Thescelus; utque manu jaculum fatale parabat
> Mittere, in hoc hæsit signum de marmore gestu.
>
> —*Ovid, Met.*, v, 181.

Thescelus insiliens sp. nov.

Plates 24, 25.

The basis of this species is a specimen which was collected for the American Museum of Natural History by Mr. Barnum Brown, in 1900, in the Laramie beds of Wyoming. The locality more accurately stated is on Seven Mile Creek, about 5 miles north of the Cheyenne River, and about 40 miles west of the town of Edgemont, South Dakota.

The specimen is a very complete one, presenting both the carapace and the plastron. The carapace is in some parts, especially at the peripherals over the bridges, considerably fractured. Very few parts are, however, missing, and the form and the general structure can be determined. Unfortunately, both the bone and the matrix filling the interior are very friable.

Traces of the sutures between the costals are present and have been indicated in the figures. It has been found impossible to determine the boundaries of the neurals. Faint traces of the sutures have lead to the provisional delimitation of the nuchal bone. The first peripherals are probably correctly represented. It is believed also that the sutures between the various bones of the plastron are correctly determined, where indicated definitely. The form and extent of the epiplastra and entoplastron are conjectural, as no traces of the sutures can be made out.

The form of this turtle is rather remarkable. Seen from above, the shell resembles that of *Caretta caretta*. It is broad, not greatly elevated, with a median frontal excavation for the neck, and narrowed behind. The plastron resembles greatly that of the species of *Baëna*. It extends, however, far beyond the front of the carapace, while it fails equally as much to reach the hinder border of the carapace. The bones are thin.

The length of the carapace (plate 24) in the midline is 397 mm. The first peripherals extend 21 mm. in front of the bottom of the anterior excavation; thus the total length is 418 mm. The greatest breadth, across the middle, is also 397 mm. The height above the plastron is 140 mm., but in life it has evidently been somewhat greater.

From the ends of the axis of greatest width the border of the carapace curves forward to the anterior excavation. Passing backward from the axis referred to, the border is at first very slightly concave to just behind the inguinal notches; then rather strongly convex for some distance; then again rather strongly concave; at length convex to the midline behind. The last concavity in the border would be over the hind legs, when extended backward. Beyond the sinuosities mentioned, there are no notches, scallops, nor indentations in the free borders of the carapace. The edge of the shell just behind the inguinal notches appears to have been somewhat flared upward; but this appearance may be due to some distortion.

In the hinder region of the carapace the peripherals are about 7 mm. thick and with acute free borders. As the border of the carapace is followed forward, it becomes more obtuse. The nuchal and the first peripherals are about 9 mm. thick. There are nowhere any carinæ or bosses on either the carapace or the plastron.

The whole surface of the carapace is covered with a hard, enamel-like layer, like that of *Compsemys*, *Glyptops*, and *Trionyx*. The ornamentation consists of raised dots and lines. The latter are sometimes straight, sometimes bent, or brancht, or anastomosing. The general effect is that of shagreened leather. On each side of the sutures between the costals a band of the surface is striated at right angles with the suture. It is from this striation, when present, that the position of the sutures can be made out. Near the rear of the carapace there are such indications of sutures as to justify the outlining of a suprapygal similar to that of *Glyptops plicatulus*.

The anterior portion of the carapace is unusually short, the abbreviation being at the expense of the first costals, the anterior peripherals, and the nuchal. The form and position of the latter are indicated provisionally, but there seems to be sufficient evidence to show that

its antero-posterior extent was only about 30 mm. Were the anterior excavation not present, the fore-and-aft extent of the nuchal would be about normal.

The first peripheral has a fore-and-aft extent of about 43 mm. Its length, parallel with the border, can not be accurately determined; it was about 65 mm. From this specimen it can not be learned where the sutures between the costal and the peripheral bones were situated, except in the case of the first peripherals. However, since in both *Glyptops* and *Baëna* these sutures, over the bridges, follow the sulci between the costal and marginal scutes, it is probable that they do so in *Thescelus*. In *Glyptops plicatulus*, behind the bridges, the sutures rise a considerable distance above the epidermal sulci; in *Baëna emiliæ*, a very little above. In *Thescelus insiliens* the structure of the surface of the bone appears to indicate that behind the bridges the sutures are placed somewhat above the scutal sulci, and they are accordingly so represented provisionally.

The number and the extent of the peripherals along the border can not be made out with certainty.

The epidermal scutes and their limits are for the most part determinable. The sulci are narrow and shallow, but usually distinct. The first vertebral is 60 mm. long in the midline, concave in front, behind, and on each side. The width behind is 75 mm., but in front it is expanded to 98 mm. The next three vertebrals are from 90 mm. to 95 mm. wide. The exact limit between the fourth and the fifth can not be determined. The fifth vertebral is 110 mm. wide.

There seems to have been no nuchal scute. The first marginal on each side is very narrow, 8 mm. to 10 mm., and extends along the free border of the carapace 30 mm. The succeeding marginals increase in height and length to the fourth, which is 55 mm. high and occupies 85 mm. of the free border. The succeeding marginals retain this width to beyond the inguinal notch; the posterior are much narrower. There were probably paired supracaudal scutes.

The plastron (plate 25) has a median length of 420 mm. The anterior lobe has a length of 117 mm. The base is 170 mm. wide, but the lobe narrows forward so rapidly that at the crossings of the gular sulci the width is only 91 mm. The posterior lobe is 110 mm. long, 168 mm. wide at the base, and 130 mm. wide at the ends of the femoro-anal sulci. The posterior end is broad, and occupied by a wide emargination 10 mm. deep.

The bridge is 194 mm. wide, fore and aft. From its inner end to the border of the carapace is about 120 mm.

The sutures bounding the epiplastron and the entoplastron are not demonstrable; hence they are represented provisionally. The thickness of the epiplastra is about 9 mm.

There are very broad mesoplastra extending across the plastron. The width of the outer end of each bone is about 100 mm., being apparently a little greater on one side than on the other. Where the bones meet at the midline they are 54 mm. wide. These mesoplastra differ from those of *Glyptops* in being proportionally larger and in having their median ends narrower than the outer. They are much like those of *Baëna emiliæ*.

The extent of the hyoplastra along the midline equals about 105 mm.; that of the hypoplastra 100 mm. The anterior borders of the xiphiplastra run straight across the plastron, except near the border of the plastron, where they send forward on each side an angular process into the hypoplastron. Just behind this process the xiphiplastron is 10 mm. thick; near the hinder end, 6 mm.

The intergulars and gulars of this species are much like those of *Baëna emiliæ*. The former, taken together, extend 30 mm. from side to side; 16 mm. fore and aft. The gulars are very large, the sulci bounding them behind meeting the midline 54 mm. behind the front of the plastron, and diverging with an angle of about 140°. If the entoplastron has been even approximately defined, the humero-pectoral sulcus falls far behind it. The fore-and-aft extent of the humerals along the midline is 87 mm. The sulci between the pectorals and the abdominals are deflected backward near the midline on each side. The pectorals occupy only 55 mm. of the midline. The femorals are 60 mm. fore and aft; the anals 72 mm. The femoro-anal sulci are directed far forward as they approach the midline, exactly as in *Baëna*.

On the bridge there are 4 large inframarginals whose boundaries have been satisfactorily determined.

The buttresses of the plastron are intermediate, in extent of development, between those of *Glyptops* and *Baëna*.

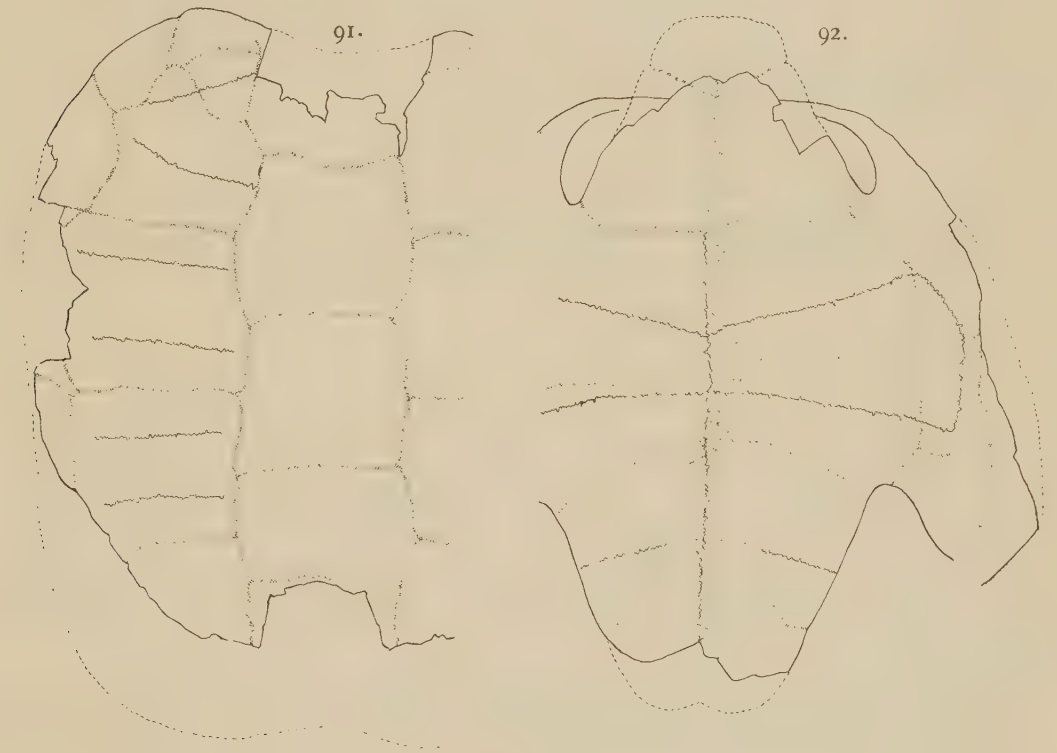
Thescelus rapiens sp. nov.

Figs. 91, 92.

This species is represented by a single shell, which was collected from Laramie deposits, at Ojo Alamo, San Juan County, New Mexico, in 1904, by Mr. Barnum Brown, of the American Museum of Natural History. The catalog number of the specimen is 6066. The shell has been damaged considerably by weathering, and lacks a portion of the carapace in the nuchal region, some portions of the right costals, most of the peripherals, the front of the plastron, and the rear of the xiphiplastrals.

The length of the carapace must have been close to 400 mm.; the width about 375 mm. Apparently the shell was considerably deprest. The front of the carapace over the neck was excavated, but not so deeply as in *T. insiliens*. The area occupied by the vertebral scutes presents a broad, shallow longitudinal channel; but in this, over the neural bones, there is a low ridge. The free borders of the anterior peripherals are rather obtuse.

The sutures of the shell are obliterated, but a few of them may be traced by the fine striations which cross them. So far as they can be made out, they are shown in the diagrammatic



Figs. 91 and 92.—*Thescelus rapiens*. Carapace and plastron. Type. $\times\frac{1}{6}$.

91. Carapace. 92. Plastron.

figures. The scutal areas are distinctly markt on the shell. They present various irregularities. The vertebrals (fig. 91) are broader than long; their dimensions are shown in the table on page 98.

On the left side there is a supernumerary costal scute. This has been cut off mostly from the first costal proper, but to some extent from the second marginal. The fourth marginal, shown on the left side, has a height of 57 mm., rising somewhat on the costals.

The plastron (fig. 92) is large. From a low ridge which joins the free border of the front lobe with that of the hinder lobe the bridges ascend at an angle with the remainder of the plastron. The axillary notch is far forward, falling about 55 mm. behind the front of the carapace. The opening for the head and legs is thus considerably restricted. The front lobe extended evidently much beyond the front of the carapace. Its length can not be determined.

The width of the base is 150 mm. The bridge is 167 mm. wide The length of the hinder lobe was approximately 100 mm.; the width at the base is 165 mm. It narrows rather rapidly backward, so that at the femoro-anal sulcus the width is 104 mm.

There are present large mesoplastra, the boundaries of which can be pretty satisfactorily determined. These are about 35 mm. wide at the midline, but they expand to about 85 mm. at the peripherals.

The median longitudinal sulcus runs a very irregular course, and across the femorals it can not be distinguisht with certainty. The humerals occupy 70 mm. of the midline; the pectorals, about 90 mm.; the abdominals, about 35 mm.; the femorals, about 52 mm. The femoro-anal sulcus runs far forward from its starting point on the border of the plastron. Probably on account of weathering, the sculpture of the carapace is nearly obliterated, appearing only in a few spots. On the plastron it is more distinct. It appears to have resembled that of *T. insiliens* and consists of narrow and low ridges and tubercles. Some traces are observed of the ridges due to the growth of the scutes.

Vertebral.	Length.	Width.
1	50±	82±
2	75	92
3	81	92
4	61	92
5	..	86

This species differs from *T. insiliens* in having the nuchal less deeply excavated, in having a median depression along the back, and in having the hinder lobe of the plastron more rapidly reduced in width backward. In *T. insiliens* the bridges are considerably wider than the base of the hinder lobe.

Genus CHARITEMYS nov.

A genus of Baënidæ. So far as known like *Thescelus*, but with the axillary buttresses ascending to near the neural borders of the first costals. Inguinal buttresses probably ascending on inner surfaces of the fifth and sixth costals, but not to so great a height as did the axillary buttresses.

Type: *Charitemys captans* Hay.

Charitemys captans sp. nov.

Text-figs. 93–95.

The type of the present species is No. 6098 of the American Museum of Natural History. It forms a part of the Cope collection of fossil reptiles and was collected in 1876, by Messrs. Sternberg and Isaac, in the Judith River deposits of Montana. There are present considerable parts of both the carapace and the plastron, but unfortunately important parts are missing.

In size this species appears to have been somewhat smaller than the type of *Thescelus insiliens*, judging from the plastral bones, but of the same size, if we judge from the widths of 6 costal bones.

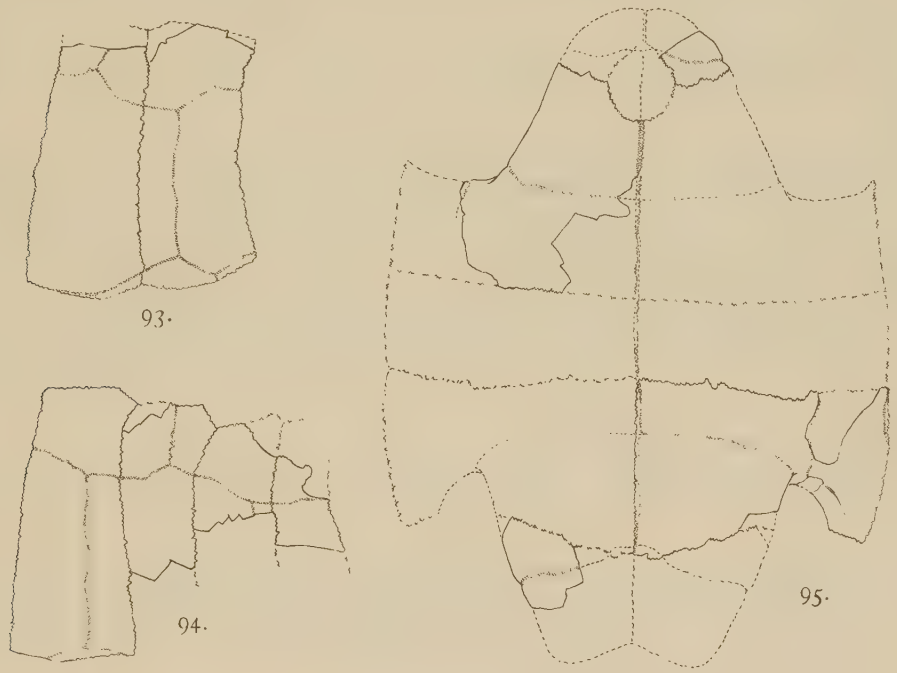
Of neurals there are portions of only two. One of these, probably the eighth, has a width of 44 mm. Its length can not be determined, what is regarded as the posterior end being broken away. On the supposed anterior end is a rounded carina. The broader end is crost by a sulcus, probably that between the fourth and the fifth vertebral scutes. On the under side are three impressions for three neural spines. The other neural is only 30 mm. wide. It probably belonged near the beginning of the series.

Of the costals there are present the proximal end of the first of the left side, the right second, third, and sixth, and the left fourth, fifth, sixth, and seventh. Fig. 93 represents the second and third right costals; fig. 94, the fourth to the seventh of the left side. Of the latter three, more or less of the distal ends are missing. The supposed first presents difficulties. On the upper surface are found portions of the first and second scute areas and of the first costal area. The area of the first vertebral scute on this costal is only 16 mm. wide. The whole width of this scute could hardly have exceeded 65 mm. On the lower side is a large triangular articular scar for the axillary buttress of the plastron. This approacht within 21 mm. of the neural border of the costal. Between the scar and the neural border is a sharp ridge from which appears to have been broken the rib-head of the costal. This was much slenderer than those of the succeeding costals. The slenderness of this rib-head was hardly to

have been expected. There is present a portion of one plastral buttress, the length of which is 72 mm.; but this has the appearance of being the inguinal buttress.

The second costal (fig. 93) has a length of 142 mm., a width of 54 mm. at the costo-vertebral sulcus, and of 60 mm. at the distal end. The proximal end is crost by the sulcus bounding laterally the second vertebral. This had a width of about 110 mm. Anteriorly it narrowed considerably. Its anterior end occupied only 18 mm. on the first costal plate. The distal end of the costal is crost by the costo-marginal sulci, a condition showing that the fourth and fifth marginal scutes overlapt on the costal bone.

The third costal plate (fig. 93) is slightly narrower than the second at the proximal end and wider than the latter at the distal end. The fifth and sixth marginal scutes overlapt slightly on the distal end. The proximal end was occupied by a part of the second and a small part of the third vertebral scutes. The fourth left costal (fig. 94) is 48 mm. wide at the costo-vertebral sulcus; 66 mm. at the distal end. That portion of the third vertebral scute on the proximal end of this costal is 48 mm. wide. The costo-marginal sulcus skirts along the distal end of the



FIGS. 93–95.—*Charitemys captans*. Costal bones and plastron of type. $\times\frac{1}{4}$.

93. Second and third right costals, the second on the right. 94. Fourth to seventh costals of left side.
95. Plastron considerably restored.

bone. The fourth and fifth costals are each 45 mm. wide. Of the seventh there is present a fragment 46 mm. long and 31 mm. wide at the sulcus. The rib-heads of the fifth and sixth costals have a diameter of about 6 mm. No trace of the articulation for the inguinal buttress appears on the parts preserved of the fifth and sixth costals. It is evident, therefore, that this buttress did not ascend to as high a point as did the axillary. From the form of the sutural border of the supposed inguinal buttress it is believed that the latter was articulated to the fifth and sixth at their junction.

Of the plastron (fig. 95) there are present a fragment of the left epiplastron, a large part of the right hyoplastron, the left hypoplastron, and a portion of the free border of the right xiphiplastron. These are represented in the diagrammatic figure.

That this turtle possest a mesoplastron is evident; otherwise, the bridges would have been only about 100 mm. wide, about one-half as wide as the costals spanned by the two buttresses of one side. No part of the mesoplastrals appears to be included among the bones present. Their antero-posterior width is only conjectural.

The piece of epiplastron present is 9 mm. thick. The gulo-humeral sulcus crosses the hinder end as in *Glyptops* and *Baëna*.

The length of the hyoplastron, from the epiplastral suture to the mesoplastron, is 120 mm. The width of the anterior lobe was about 142 mm. The distance from the axillary notch to the mesoplastron measured very close to 50 mm. The thickness of the bone at the entoplastral suture is 6 mm. The free border in front of the axillary notch is subacute. Most of the border which rose to meet the peripherals is broken away. A portion of the sulcus between the abdominal scute and the anterior inframarginal is present.

The length of the hypoplastral at the midline is 90 mm.; the width at the base of the hinder lobe, 80 mm.; the width from the midline to the union with the bridge peripherals, 130 mm. A portion of the outer end of the bone is missing, but a section of the sulcus is seen starting forward from the inguinal notch and section of another sulcus between the hinder inframarginal and the contiguous marginals. The hinder inframarginal has a width of about 45 mm. Its anterior end appears to have extended on the mesoplastron.

The fragment of xiphiplastral is 53 mm. long. It shows the free border. This is subacute, and from it the bone thickens soon to 10 mm. No portion of the upper surface was covered with scutes. On the lower surface the femoro-anal sulcus crost the bone about 30 mm. behind the suture with the hypoplastron. The form of the hinder border of the lobe can not be determined.

Of the skull there is present the pedicel of the left quadrate. The condyle for the lower jaw is concave, 11 mm. from side to side, and less than 5 mm. antero-posteriorly. At the inner side of this condyle there ascends toward the lower end of the parietal plate a sharp ridge. The rough surface for the pterygoid lacks 8 mm. of reaching the condyle, a fact that shows that this genus did not belong to the Pleurodira.

The upper surface of the carapace was more or less uneven, especially along the midline. All the articular borders of the bones are striated perpendicularly to the sutures. Besides this, there is a delicate pitting of the surface which gives the effect of leather. The lower halves of the costals are markt by coarse ridges, which have been produced during the growth of the costal scutes.

The plastral bones have all the sutures conspicuously markt by striæ, which run at right angles with the sutures. The whole surface is occupied by a fine network of delicate lines.

Genus POLYTHORAX Cope.

An insufficiently known genus of uncertain position. Plastron suturally united with the carapace; furnisht with the usual scutes, besides intergulars and interhumerals. Lower jaw with narrow ramus; the triturating surface bounded outwardly by a sharp margin; the symphysis short.

Type: *Polythorax missuriensis* Cope.

This genus is arranged provisionally among the Baënidæ; but it is probable that it and *Archæochelys* Lydekker belong to a distinct family.

Polythorax missuriensis Cope.

Polythorax missuriensis, Cope, Proc. Acad. Nat. Sci. Phila. 1876, p. 258; Bull. U. S. Geol. and Geog. Surv. Terrs., III, 1877, p. 573.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.—Hatcher, Bull. U. S. Geol. Surv. 257, 1905, p. 77.

It is not at present known what has become of the type of this species. It was found in the Judith River deposits of Montana, in 1876. The plastron appears to have been pretty complete, but we are not told how much of the carapace was secured. No part of the species has ever been figured.

The plastron had a total length of 183 mm.; hence the individual was not a large one, perhaps attaining about the size of our *Trachemys elegans*. The anterior lobe had a length of 49 mm. The bridge was 76 mm. wide and as long. The anterior lobe is stated to have been narrower at the base than the bridge. We must conclude therefore that this lobe was not one-third as wide as the carapace. Its anterior extremity was rounded. The width of the base of

the hinder lobe is not given, but its posterior extremity was 35 mm. wide, truncated, and with rounded angles. It was shorter than the anterior lobe. Its thickness in the inguinal region was 10 mm.

The surface of the plastron was obsoletely, but coarsely, rugose; roughest in front, where the sculpture consisted of short, raised lines irregularly disposed.

The intergulars were distinct. These were followed by a pair of interhumerals, which were longer than wide and crowded the humerals away from each other, and they seem to have extended themselves backward between the pectorals likewise. The pectoro-humeral sulcus appears to have been advanced well forward. Cope states that it was impossible to determine whether or not "intermarginal" scutes were present, and that if they existed their position was quite external. It is probable that by "intermarginals" was meant inframarginals.

The carapace is stated to have possest an openly dentate posterior border. The surface was irregularly swollen, especially along the margins of the vertebral scutes. The latter were wide; the marginals are said to be narrow, by which is probably meant that they rose but a short distance from the free margins.

The description of this species given by Cope indicates that it was related to *Baëna* rather than to *Adocus*. The thoro co-ossification of the bones, so that the presence of mesoplastrals could not be proved or disproved, the uneven surfaces of the shell, the notcht border of the carapace, all point toward *Baëna*. At the same time, the presence of the interhumerals marks it off as different from all North American turtles hitherto described. *Archæochelys* (Lydekker, Cat. Foss. Rept., pt. III, 1889, p. 219), from the Wealden of England, has the humerals separated by what has been regarded as an intergular, but which is quite as likely an interhumeral. Behind this come in succession an interpectoral, an interabdominal, and an interfemoral. The latter extends itself backward between the anals also. That is, the scutes which usually join in pairs along the median line are here separated the length of the plastron by a series supposed to be azygous. These median scutes in both *Polythorax* and *Archæochelys* are probably homologous with the median series of *Dermochelys*.

Mr. Lydekker places his genus provisionally in the Amphichelydia.

Genus NAOMICHELYS nov.

A genus known only from the entoplastron. Outer surface ornamented with elevations resembling small shot. A long narrow scute (intergular or interhumeral) occupies most of the length of the bone. Gulars ? and humerals ? present.

Type: *Naomichelys speciosa* Hay.

The relationships of this genus are not certain. It may belong among the Pleurosternidæ rather than among the Baënidæ. It is here put in the vicinity of *Polythorax*.

Naomichelys speciosa sp. nov.

Plate 40, figs. 2, 3.

The only portion of this species at present known is an entoplastron which was collected in 1904, by Mr. Barnum Brown, of the American Museum of Natural History. It was secured in the Upper Jurassic, Morrison beds, 25 miles east of Pryor, Montana. The catalog number is 6136. The bone is complete, except that the extreme anterior end is broken away. The bone is 85 mm. long, and was originally about 10 mm. longer. The width is 78 mm. The thickness is quite uniformly close to 7 mm. Where the bone joined the epiplastra the upper surface extends out a little farther than the lower. The hyoplastrals overlapt extensively the entoplastron, as may be seen from plate 42, fig. 3. Fig. 2 of the same plate shows the scutes and the ornamentation of the inferior surface. Five scutes are represented in the bone. There is a long median scute which narrows forward, as well as backward. It seems probable that anteriorly it did not extend beyond the bone. This scute may be the intergular which was crowded backward by the gulars as in *Chelodina novæguineæ* (Boulenger, Cat. Chelonians, pl. vi), or it is possibly an interhumeral or an interpectoral. Attention is called to Cope's *Polythorax* and Lydekker's *Archæochelys*.

On each side of the scute just described is another which may be either an intergular or a gular. Behind this is a large scute which is assumed to be the humeral.

The surface of the bone is covered with rounded elevations which resemble small bird shot. There are about eight in a line 10 mm. long. The basis of each elevation is often of less diameter than the body of it. Many of them are broken off near the surface of the bone, leaving circular scars. Along the edges of the bone which joined the hyoplastra there is a narrow border nearly free from the pustules.

This turtle differed from *Polythorax missuriensis* in the character of the ornamentation, this consisting in the latter species of short raised lines. In that species, too, the pectoro-humeral sulcus appears to have been pushed well forward. In the species here described there is no trace of the presence of this scute.

Superfamily PLEURODIRA Cope.

Thecophorous turtles having a carapace composed of costals and peripheral bones and usually a series of neurals and a plastron in which the epiplastra are in contact with the hyoplastra. Mesoplastra present or absent. Intergular scutes developt, the inframarginals wanting. Temporal roof of the skull varying from nearly complete to nearly obsolete. Pterygoids not extending backward between the quadrates and the basisphenoid; broad, with the outer border uprolled. Neck bending sideways; not capable of being withdrawn between the scapulæ. Ilia suturally joined to the eighth costals; the pubes and the ischia, to the xiphiplastra.

The living Pleurodira are divided by Boulenger into 2 families, the Pelomedusidæ and the Chelydidæ. About 30 species are known. None of these have had the anterior limbs transformed into flippers, like those of the Cheloniidæ. The geographical distribution of the living species is illustrated by fig. 15, on page 34. The earliest turtles certainly known to belong to this superfamily occur in the Upper Cretaceous of North America. Cope referred these to the Pelomedusidæ; but the present writer, following Baur, accepts for them the family Bothremydidæ. So far as is known, no species of the superfamily lived in North America after the end of the Upper Cretaceous.

Family BOTHREMYDIDÆ Baur.

Extinct pleurodire turtles having the skull probably extensively rooft over in the temporal region. Vomer present. Triturating surfaces of the jaws, upper and lower, broad and deeply excavated. Shell as in the Pelomedusidæ, with small mesoplastra.

Baur was the author who proposed this family, making it include *Bothremys* and *Taphrosphys*. Cope had arranged these genera under the Podocnemididæ. To the present writer it appears that the presence of a vomer, but still more the extraordinary excavations found in the jaws, upper and lower, are sufficient to set off *Bothremys* as a member of a distinct family. With it must go for the present *Taphrosphys*.

Key to the Genera.

A. Known from skull only:
  Each side of jaws, upper and lower, with a deep pit ..... *Bothremys*
AA. Known from shell only:
  1. Nuchal bone not shortened; free borders of peripherals acute ..... *Taphrosphys*
  2. Nuchal short and broad; free borders of peripheral obtuse ..... *Amblypeza*
  3. Only the xiphiplastron known; the ischiadic scar extending to the midline ..... *Naiadochelys*

Genus BOTHREMYS Leidy.

Vomer well developt, not separating the palatines. Choanæ behind the centers of the orbits. The nasal passages underfloored by the surrounding bones. Crushing surfaces of jaws broad and occupying portions of the maxillæ and of the palatines; the excavation contracting to a pit in each. Lower jaw with the dentaries co-ossified. Shell unknown.

Type: *Bothremys cooki* Leidy.

It has been suspected that the skull represented by the type of *Bothremys* is that of some species of *Taphrosphys*, all the species of which are known only from shells. This is entirely possible, but nothing is to be gained at present by reducing *Taphrosphys* to a synonym of *Bothremys*.

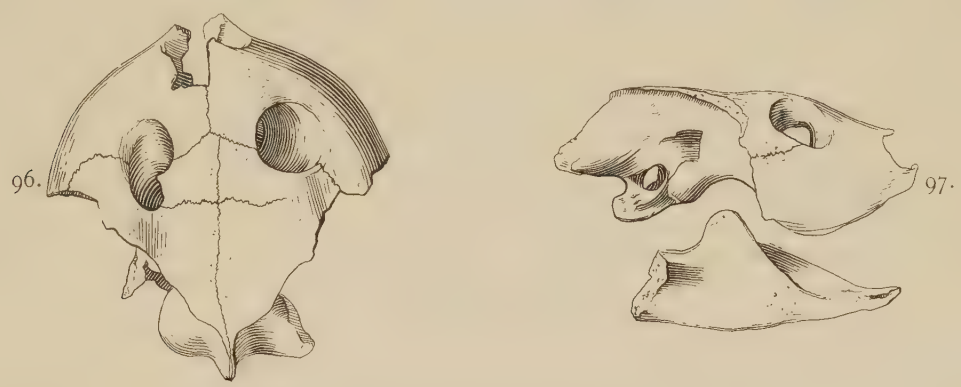
Bothremys cooki Leidy.

Plate 23, figs. 2, 3; text-figs. 96, 97.

Bothremys cooki, Leidy, Smithson. Contrib. Knowl., xiv, art. vi, 1865, pp. 110, 120, plate xviii, figs. 4–8.—Cope, Cook's Geol. New Jersey, 1868 (1869), p. 735; Amer. Naturalist, iii, 1869, p. 89; Ext. Batrach., Reptilia, Aves N. A., 1870, p. 157; Vert. Cret. Form. West, 1875, p. 263.—Maack, Palæontograph., xviii, 1869, p. 280.—Baur, Ann. and Mag. Nat. Hist. (6), iv, 1889, p. 38.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.

The skull which has furnisht all that we know of this species is a most extraordinary one. It was found in the lower bed of greensand, belonging to the upper Cretaceous, near Barnesboro, Gloucester County, New Jersey, and is now in the geological collection of Rutger's College, New Brunswick, New Jersey, where the writer has been permitted to examine it. It was fully described and figured by Leidy in his original description. His figures are stated to be of the size of nature, but they are really somewhat reduced. Plate 23, figs. 2, 3, of the present work is reproduced from drawings belonging to the U. S. Geological Survey. These were prepared in 1888 for Dr. George Baur, who was then preparing to monograph the fossil turtles. The one showing the lower surface of the skull differs from that of Dr. Leidy in indicating the positions of the sutures. It will be observed that in this drawing the missing quadrate regions are restored in outline.

The skull, from the tip of the snout to the occipital condyle, had originally a length of close to 70 mm. The width at the hinder end of the maxillæ is 70 mm. From the latter point



Figs. 96 and 97.—*Bothremys cooki*. Skull of type. $\times\frac{2}{3}$.

96. Seen from above. 97. Seen from right side.

the outline of the skull rounds rapidly to near the end of the snout. Just before this is reacht the curves change somewhat, so that the snout is slightly prolonged. The skull is flat above (text-figs. 96, 97) there being a slight descent from the orbits forward. The interorbital space is 17 mm. wide. The eyes lookt strongly upward. Both diameters of the orbits measure 14 mm. From the upper borders of the orbits the sides of the face sloped downward and outward with a moderate curvature. The outline of the upper jaw, seen from the side, is very convex. The nasals are absent. Whether or not the temporal region was widely rooft over is uncertain, but it is probable that such was the case.

A view of the lower surface of the skull shows many interesting features. The premaxillæ are large, extending backward a distance of 18 mm. Behind these comes the well-developt vomer, which presents feeble palatine plates, to aid in underflooring the nasal passages. The length of the vomer as seen from below is 15 mm. It lacks much of reaching the pterygoids. The palatines meet the vomer in advance of the choanæ. The anterior borders of the choanæ are placed 24 mm. behind the tip of the snout. These choanæ lie in a vaulted excavation, which, beginning on the premaxillæ and expanding backward, reaches to the postpalatine foramina, being shallow in front of the choanæ. The excavation is bounded on each side by a prominent tootht ridge, the inner boundary of the triturating surface of the jaw. The pterygoids meet along the midline a distance of only 7 mm. As in the Pleurodira gener-

ally, the pterygoids are wide, and the outer border is uprolled in a scroll-like manner. The basisphenoid, most of which is present, is large, the width being 13 mm.

The most striking feature of the skull is presented by the triturating surfaces of the upper jaws. On the premaxillæ they are very narrow. Backward each expands rapidly and occupies most of both the maxilla and the palatine. The greatest width is 24 mm. Each, instead of being flat, is deeply excavated. At the suture between the maxilla and the palatine the excavation contracts into a circular pit which rises in the maxilla to the height of the floor of the orbit. The walls inclosing this pit are smooth. The remainder of the triturating surface is perforated by openings for blood-vessels.

The lower jaw shows little else than the co-ossified dentaries. These are of very solid construction. The jaw as a whole is thin and pointed in front, but the coronoid processes rise to a height of 27 mm. The symphysis has a length of 20 mm. The triturating surfaces are as remarkable as those of the upper jaw. Each may be described as containing a deep pit, situated at the hinder end of the dentary and opening forward and upward, trumpet-like, on the upper surface of the dentary. The trumpet-shaped mouth extends forward to near the tip of the jaw. It is bounded outwardly by the cutting-edge of the jaw; inwardly by a ridge, which rising at the tip of the jaw, runs backward and upward, increasing in height to the coronoid process, along the inner border of the ramus.

The purpose of the pit-like excavations in the jaws, upper and lower, is problematical. In speaking of the pit in the upper jaw Leidy said that it did not appear like an alveolus for a tooth, but that it may have accommodated a corneous tooth-like process springing from the corresponding hollow of the lower jaw. Baur thought that the pits lookt much like the alveoli of large tusk-like teeth.

It does not appear probable that there were any teeth in this turtle. It seems far more probable that both jaws were covered with plates of horn, as are those of all other known turtles. The whole construction of the skull of *Bothremys* indicates that it was accustomed to crush hard objects as food. Probably these objects were of such a nature that economy of force demanded that they should be brought to a particular spot on the jaw for crushing. To provide for the rapid reproduction of the horn beneath these areas for crushing, these pits became developt in a way analogous to the human "nail-bed."

Genus TAPHROSPHYS Cope.

Prochonias Cope.

A genus of pleurodirid turtles known only from the shell. Carapace with 7 neurals, the costals of the seventh and eighth pairs meeting their fellows at the midline; a large suprapygal; and 11 pairs of peripherals, the posterior thin and with acute free borders. No nuchal scute. Plastron with 11 bones, the mesoplastrals small and well out on the bridges. A single intergular almost wholly confined to the entoplastron. Hinder lobe with large notch. Large pits in the first and the fifth costals for the axillary and inguinal buttresses. Ilium firmly articulated with the carapace at the junction of the seventh and eighth costals. Ischium and pubis articulated to the xiphiplastron.

Type: *Platemys sulcatus* Leidy.

In Cook's Geology of New Jersey, 1868 (1869), page 735, Cope mentions the generic name *Taphrosphys* in connection with 3 specific names, as follows: *T. molops*, *T. princeps*, and *T. sulcatus*. The first two had not yet been described, the last was Leidy's *Platemys sulcatus*. In the April (1869) number of the American Naturalist, Cope again mentions the name *Taphrosphys*, this time in connection with *molops* only, while to the new genus, *Prochonias*, were referred the species *P. sulcatus*, *P. strenuus*, and *P. princeps*. Of these again none had yet been described except *P. sulcatus* (Leidy). The latter therefore is the type both of *Taphrosphys* and *Prochonias*. Which of these names has precedence depends on which was issued first to the public, the April number of the American Naturalist or Cook's Geology of New Jersey. Investigations not wholly satisfactory seem to show that the latter was first publisht, probably some time about the first of March, 1869. This conclusion enables us to

retain the name to which Cope finally referred all the species named above and some others. In his monograph of 1869 and 1870, he described all his species and made *Prochonias* a subgenus of *Taphrosphys*. Here *T. molops* was regarded as the type of *Taphrosphys*.

All the species known to belong to this genus are represented by fragmentary individuals, but these furnish us the means of obtaining a pretty clear idea of the structure of the carapace and the plastron. Nothing is known regarding the skull, unless it be that the skull known as *Bothremys cooki* belongs to a species generically identical with *Taphrosphys*. Of the limbs extremely little is known. Evidently the genus belonged to the Pleurodira and was not far removed from *Podocnemis*. There were 8 pairs of costal bones, the last two pairs meeting on the midline. The nuchal bone is large and expanded behind. There were seven neurals, the first large, the last small. There were 11 pairs of peripherals, a suprapypal and a pygal. The peripherals of the hinder part of the carapace were thin and acute. Those of the anterior portion of the bridge, the fourth and fifth, appear to have had the free border thickened and rounded or with faces at right angles; while those succeeding them had the free borders acute and the faces, upper and lower, meeting at an angle less than right.

On the inferior side of the first costal was a deep pit for the reception of the axillary buttress; on the fifth was another pit for the inguinal buttress. An extensive excavation, partly in the seventh costal and partly in the eighth, received the upper end of the ilium. This excavation occupied more than a half of the length of these costals.

The upper surface of the carapacial bones is markt by irregular grooves, which anastomose more or less and divide it into areas differing in size and form in the different species and on different parts of the same individual. The sulci are shallow and sometimes obscure. Evidently, the epidermis was thin. There was no nuchal scute. The vertebrals were rather broad. The marginals did not overlap on the costal bones.

The plastron was well developt, but the anterior lobe was short and broad, and rounded. Strong buttresses rose from the plastron to articulate with the carapace. On the xiphiplastrals were well-developt articulatory surfaces for union with the ischia and the pubes. The posterior notch was large and rounded. As stated by Cope, and as shown by the borders of various hyoplastra and hypoplastra, there were small triangular mesoplastra, which occupied each a position on its bridge. The free borders of the anterior lobe were mostly obtuse; those of the hinder lobe were mostly acute. The inferior surface is sculptured like the carapace; but often the markings are obscure. The scutes of the anterior lobe are not all satisfactorily determined. There was a large intergular that occupied a considerable part of the entoplastron. Apparently, as shown in the figure of the anterior lobe of *T. molops* (fig. 116), this was bounded in front by a sulcus across the entoplastron, thus permitting the gulars to meet each other at the midline. It is possible that the intergular extends to the front of the lobe, as represented in fig. 106, and that the gulars do not join each other. The humerals lie on the outer ends of the epiplastra, overlapping on the hyoplastra. The arrangement of the other plastral scutes may be seen from the figures. Those on the bridges are not known.

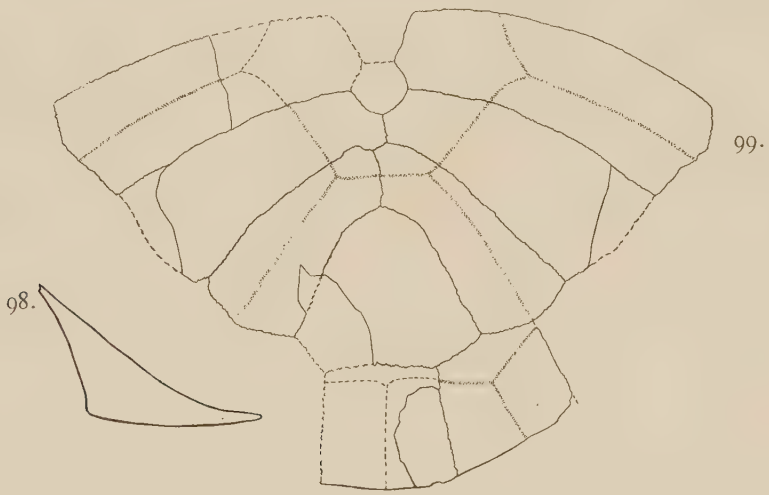
A[1]. Species with shell having an even surface, except that it bears a network of vascular grooves.
  a[1]. Surface of shell usually with a close network of rather broad grooves.
    1. A large species with bones of moderate thickness; the fourth vertebral scute nearly a half wider than long ..... *sulcatus*
    2. A species of moderate size; second and fourth vertebral scutes little wider than long ..... *longinuchus*
    3. A small species with thin bones; second vertebral scute twice as wide as long; the fourth probably as wide as the second ..... *leslianus*
    4. A large species with thick bones; front of plastron broad, truncated, or concave on each side of the thickened epiplastral symphysis ..... *strenuus*
    5. A large species with bones of moderate thickness; front of plastron rounded; the first and third vertebral scutes about one-half wider than long ..... *molops*
  a[2]. Surface with thread-like grooves which form large meshes.
    A large species with thick bones; entoplastron broader than long, its postero-lateral sides excavated ..... *dares*
A[2]. Surface of shell coarsely sculptured like that of the Trionychidæ ..... *nodosus*

Taphrosphys sulcatus Leidy.

Text-figs. 98–100.

Platemys sulcatus, Leidy, Proc. Acad. Nat. Sci. Phila., viii, 1856, p. 303; Smithson. Contrib. Knowl., xiv, art. vi, 1865, pp. 109, 120, plate xix, fig. 4.—Maack, Palæontographica, xviii, 1869, p. 281.
Taphrosphys sulcatus, Cope, Cook's Geol. New Jersey, 1868 (1869), p. 735; Ext. Batrach., Reptilia, Aves N. A., 1870, pp. 159, 164, text-figs., 45, 45 *bis*; Vert. Cret. Form. West, 1875, p. 264.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 439.
Prochonias sulcatus, Cope, Amer. Naturalist, iii, 1869, pp. 89, 90; Ext. Batrach., etc., p. 165, line 8, plate xi, fig. 2.

As has occurred too often in the history of paleontology, the present species was based on very meager materials. These consisted of 3 peripheral bones, regarded as the fifth, sixth, and seventh, and a xiphiplastral. Only the peripherals were figured. These were large, measuring altogether 8 inches along the free border. They came from the Cretaceous greensand at Tinton Falls, Monmouth County, New Jersey, and are preserved in the geological collection of Rutgers College, New Brunswick, New Jersey. Leidy's description of these bones is very brief. Each bone has two faces, an upper and a lower, the lower broad and flat, the upper inclining toward it at an angle of nearly 45°, the two meeting along an acute margin. The fifth is 54 mm. long on



Figs. 98 and 99.—*Taphrosphys sulcatus*. No. 1468 A. M. N. H.

98. Section of seventh peripheral of type. ×½. 99. Rear of carapace. ×¼.

the free border; the sixth, 60 mm.; the seventh, 76 mm. The sixth rises from the free border to the costal border, 69 mm.; the seventh, 70 mm. The anterior end of the seventh is much thickened and has afforded an articulation with the inguinal buttress. In front of this articulation the bone is somewhat excavated by the sternal chamber. The hinder end of this peripheral is thin, not exceeding 14 mm. (fig. 98). The free borders of all these peripherals are acute. The superior surface is ornamented by a close articulation of grooves. Fig. 98 represents a section along the sulcus between the marginal scutes that overlapt this bone. The piece of xiphiplastron displayed the scar for union with the pelvis.

With this species Cope identified a specimen which he obtained from the upper greensand bed at Barnesboro, Gloucester County, New Jersey. This specimen furnisht him the three hinder pairs of costal plates, the suprapygal, the pygal, and a number of the hinder peripherals. There are present also portions of two bridge peripherals and some fragments of other costals. There appears to be no reason for doubting the correctness of Cope's identification. This specimen (figs. 99, 100) is now in the American Museum and has the catalog number 1468. It now lacks all the peripherals that Cope figured, except one. According to his figure, Cope lackt the eleventh peripheral. The one now present was certainly in Cope's hands, having his marks on it; and yet, after careful examination, that bone is found to fit in the place of the

right eleventh peripheral and nowhere else. With it is connected a portion of the pygal. The proximal half of the left sixth costal is now missing. On the other hand, the distal end of the right seventh costal has been found and included in the figure.

The individual was a large one, the length of the carapace being estimated at 650 mm. Cope states that his figure is one-third the natural size, but in reality it is in width only a little more than twenty-two hundredths of the original. As regards the length of his figure, it is much foreshortened.

As in the other species, the costals of the last two pairs (fig. 99) meet at the midline. The eighth neural was not developt and the seventh was short. The sixth costals are 66 mm. wide at their distal ends; the seventh, 70 mm., the eighth, 54 mm. The sixth is 9 mm. thick where it joined the neural; 5 mm. at the distal end.

The suprapygal, described by Cope under the name of pygal, is triangular, pointed above, 83 mm. long and 99 mm. wide behind. The eleventh peripheral measures 72 mm. along the free border and is 65 mm. high. The free edge is acute. It is slightly thicker at the hinder end than in front, being 10 mm. posteriorly.

Fragments of two bridge peripherals are present. One, probably belonging near the hinder end of the bridge, has the two faces meeting with an angle of about 50 degrees between

FIG. 100.—*Taphrosphys sulcatus*. Under side of rear of carapace. ×¼. No. 1468 A. M. N. H.

AA, excavated area for ilium; *x*, sacral rib.

them at one end, probably the anterior. At the other end the faces meet at an angle of about 30 mm., the free border being acute. The other fragment has the two faces meeting at an angle of about 90°. This bone probably belonged near the front end of the bridge.

As Cope states, the sculpture of the upper surface of the carapace is coarsely reticulate, tending to enclose areas longitudinal with the costals toward their middle and distal portions, while that of the peripherals is closer. The sulci are shallow and narrow. The fourth vertebral scute was about 110 mm. long and 154 mm. wide; the fifth was 110 mm. long, 162 mm. wide, only 50 mm. anteriorly. Its lateral extremities are sharply angled. The costo-marginal sulci, so far as they are represented, are confined to the peripherals.

On the inferior surface of the carapace (fig. 100) we find, excavated partly in the seventh, partly in the eighth costals, a large pit, 78 mm. long and 28 mm. wide, for the reception of the upper end of the ilium. The pit is bounded anteriorly by a sharp ridge proceeding from the rib-head of the seventh costal. This ridge is highest at the upper end, lowest in the middle. Behind, the pit is bounded by a low rough ridge running along the middle of the eighth costal. Both the costals are much thickened at the lower end of the pit. The upper end of the pit is inclosed in front by a low ridge derived from the base of the rib-head of each costal; behind, by a distinct squarish bone, which is to be regarded as the tenth dorsal rib, corresponding to the

enlarged extremity of the tenth dorsal rib of the Cryptodira. On its hinder angle is a broken process, apparently the base of the rib-head. The distal end of this bone abutted squarely against the ilium. Behind this squarish bone is an irregular and rough excavation in the eighth costal, which seems to have received another bone, probably the first sacral rib. Behind the rough surface just mentioned is another, lying partly on the anterior border of the suprapygal; and this may have supported the second sacral rib, not yet lost in these early Pleurodira.

On the contiguous ends of the seventh and the eighth costals, in the midline, are 3 rough articular surfaces which were in contact with the neural arches of three vertebræ. Cope speaks of these as having been in contact with "rudimental and inferiorly placed vertebral pieces." It seems evident that the rib-head of the eighth costal was connected with the most anterior; the rib-head of the tenth rib with the second; while the first sacral rib-head joined the third.

The portion of the xiphiplastron present shows this part of the shell to have been thinner than in *T. molops*. The thickness at the hypoxiphiplastral suture is 7 mm. The edge of the bone at the bottom of the posterior notch is present. This edge is acute, while from it the bone thickens to only 9 mm. The scar for the pubis is somewhat elongated, 46 mm. long and 9 mm. wide; therefore, much narrower than in *T. molops*. On the inferior surface is seen a distinct reticulate sculpture of moderate closeness.

No. 1469 of the American Museum, a part of the Cope collection, is labeled by Cope as having been found at Barnesboro, New Jersey, in 1869; but it has not been identified as any one of those mentioned in his monograph so often quoted here. The left second costal bone is 39 mm. wide at the middle of the length and 8 mm. thick. The third costal is 49 mm. wide at the middle of its length. Besides these costals, there are present portions of the three posterior of the right side. These agree with those of No. 1468 described above. Attacht to the sixth costal is the sixth neural. It is hexagonal, 35 mm. long, 36 mm. wide, and 8 mm. thick. The epidermal scute areas also are like those of number 1468. The lateral apex of the second vertebral is 67 mm. from the neural border of the costal. Most of the right hypoplastron is preserved. The length at the midline is about 105 mm.; the width at the abdomino-femoral sulcus 130 mm.; along the hyohypoplastral suture, 100 mm. The bone is 8 mm. thick at the anterior inner angle; 6 mm. at the hypoxiphiplastral suture.

This species differs from *T. longinuchus* in having the suprapygal wider than long and in having the fourth vertebral scute relatively much wider.

Taphrosphys longinuchus Cope.

Text-figs. 101, 102.

Taphrosphys (Prochonias) longinuchus, Cope, Ext. Batrach., Reptilia, Aves N. A., 1870, p. 159.
Taphrosphys longinuchus, Cope, op. cit., p. 162; Vert. Cret. Form. West, 1875, p. 263.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.

Cope stated in his description of this turtle that it had been obtained from the excavations of David Haines, New Jersey. The label accompanying the specimen, now number 1125 of the American Museum of Natural History, informs us that the locality was Medford, which is in Burlington County. The level is stated by Cope in his Vertebrata of the Cretaceous Formations, page 263, as being "Greensand No. 5," which would be the upper bed of Cretaceous greensand.

Neural.	Length.	Width.
1	48	..
2	34	..
3	35	..
4	35	26
5	32	22
6	26	22
7	21	20

The type specimen furnishes a large portion of the carapace and of the plastron, but it was much fractured. Fig. 101 represents the restored carapace; fig. 102 the restored plastron. A considerable number of other fragments remain, but can not be fitted to their places.

The species was one of moderate size and one whose shell was of rather light construction. The length of the carapace (fig. 101) was close to 415 mm.; the width about 390 mm. The form was deprest and convex in all directions. Only the eighth peripheral shows any tendency toward upward flaring. Only 3 neurals have been preserved—the fourth, fifth, and seventh. The forms of most of the others are indicated by the proximal ends of the contiguous costals. The dimensions, so far as determinable, are given in the accompanying table.

The borders of the fourth and fifth neurals are 8 mm. thick. On the under side of each is attacht the neural arch of the corresponding vertebra. The eighth neural was not developt and the costals of the seventh and eighth pairs met at the midline. The ninth and tenth dorsal vertebræ and the first sacral appear to have had their arches articulated with the inferior surface of the seventh and eighth costals at their junction. The accompanying table gives the dimensions of the three posterior neurals.

Neural.	Length.	Height.
8	66	67
9	57	58
10	50	49

The nuchal bone is urn-shaped, 90 mm. long, 43 mm. wide in front, 86 mm. across the widest part, and 10 mm. thick. Its free border is acute. The first peripheral measures 58 mm. along its free border; the second, 53 mm. The first appears to have been about 60 mm. high, measured at the suture with the second. The free border of these two peripherals is subacute. The greatest thickness of the second, at the distal end, is 12 mm. On the right side most of the peripherals are wanting from the second to the eighth (exclusive of both); all are missing behind the second on the left side, except one, probably the sixth. The upper and lower faces of this sixth meet at the acute free border at an angle of about 45°. This border is 45 mm. long and from this the bone rises 56 mm. to the costals. In the restoration (fig. 101), this bone has been omitted from its supposed place. The lower face of the bone, that proceeding to the plastron, is mostly missing.

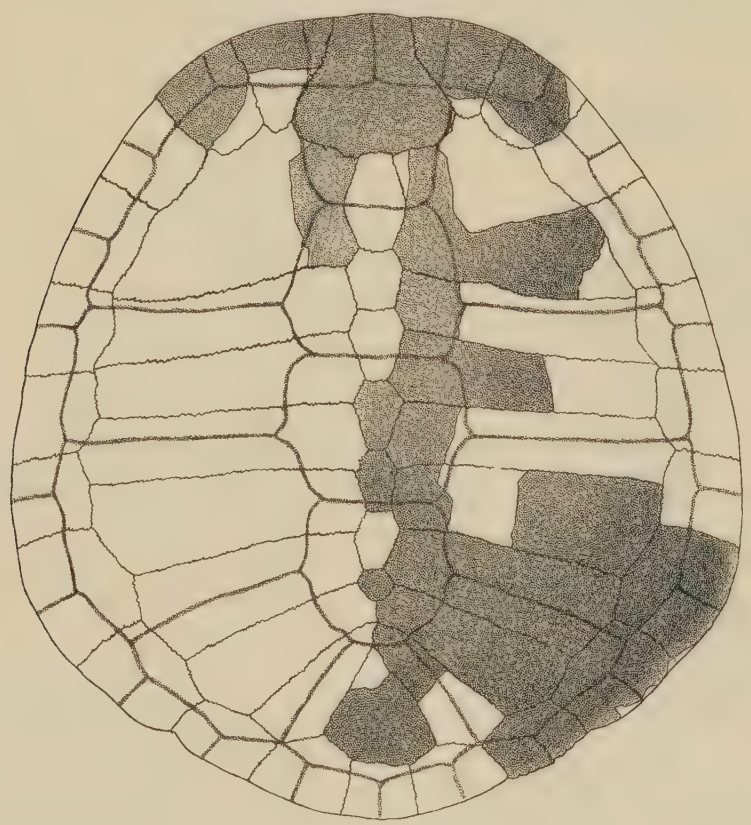


FIG. 101.—*Taphrosphys longinuchus*. Carapace of the type. ×¼. The stippled areas represent the known bones.

All of the peripherals have acute free borders. Of the eighth, that portion to which the inguinal buttress was attacht is broken away. From the free border each of these bones thickens on the under side to half its height, then becomes gradually thinner.

The suprapygal is triangular, 62 mm. long and 60 mm. wide posteriorly. Evidently it articulated on each side with the eleventh peripheral and medially with the pygal.

The fore-and-aft width of the first costal is 64 mm. at the proximal end; its greatest width was about 90 mm. Its length is estimated at 120 mm. On the lower side, at the distal end, is a deep triangular excavation, 40 mm. long, for the axillary buttress. From it a broad ridge ascends to the rib-head of the costal. In front of the ridge, along its proximal third or more, is another ridge, sharper and more prominent, representing the first rib.

The fifth costal is 6 mm. thick at its distal end. On the under surface of the distal end is an excavation for the inguinal buttress, a groove ascending about 60 mm. above the peripheral border and 6 mm. wide. It is deepest at the upper end, becoming very shallow at the lower end.

The seventh and the eighth costals are modified for close articulation with the ilium. On the seventh the thickening produced by the rib proper lies near the hinder border of the bone. The hinder part of the thickening is excavated somewhat, especially near the proximal end of the costal, to form a broad groove for the ilium. The proximal end of the groove is closed partly by the ridge proceeding from the rib-head of the eighth costal and partly by a subcubic bone, which appears to be the tenth rib. This lies in a depression of the eighth costal. The iliac groove is 18 mm. wide at its upper end; and here its bounding walls are most prominent. Behind the ridge limiting the groove posteriorly is another groove, shallower and roughly excavated, which appears to have lodged a bone, probably the first sacral rib.

Vertebral.	Length.	Width.
1	75	80
2	75	77
3	75	90
4	75	86
5	..	110

The surface of the carapace is even, but it is sculptured everywhere by a network of shallow grooves. On the costals the network is the coarsest, the grooves lying from 2 mm. to 5 mm. apart and mostly directed parallel with the length of the costal. On the neurals and peripherals the network is much closer.

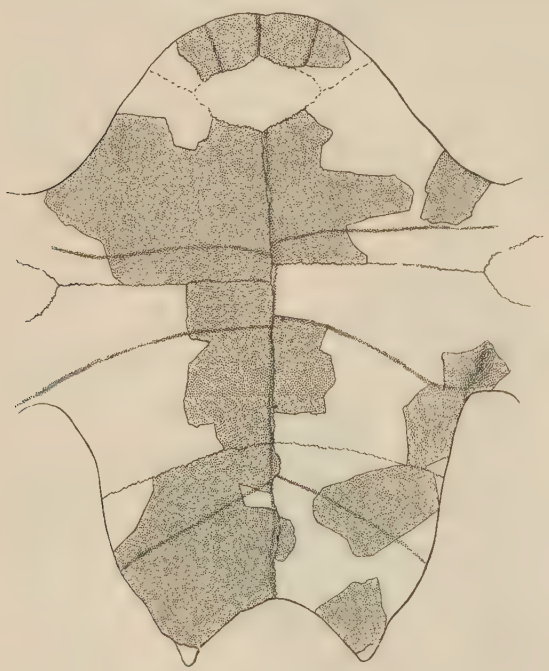


FIG. 102.—*Taphrosphys longinuchus*. Plastron of type. $\times\frac{1}{4}$. Known portions represented by stippled areas.

The sulci of the carapace are broad and shallow. There is no nuchal scute, the first marginals joining at the midline a distance of 44 mm. The length of the sulcus between the first and the second marginals is 44 mm.; that between the second and the third, 23 mm. The sulcus between the eighth and ninth marginals, on the eighth peripheral, is 37 mm. long; the next one, 31 mm.; the next, 27 mm.

The vertebral scutes of this species are much narrower than those of *T. leslianus*, as shown by the table above.

The sulcus between the fifth vertebral and the hindermost marginals falls behind the suprapygal.

The exact length of the plastron (fig. 102) can not be determined, the connection between the epiplastron and the hyoplastrals not being present. The length was, however, not far from 340 mm. The notch in the rear of the plastron was about 30 mm. deep, so that the length along the midline was about 310 mm. The epiplastrals are relatively small, especially when compared with those of *Hydromedusa*. The hinder end of each is broken off, but each was probably about 70 mm. long. The width was about 33 mm., while the greatest thickness of the outer end is 7 mm. The free border is acute at the midline, becoming subacute distally. Cope describes, under the name of mesosternal, a portion of the entoplastron, but this is now lost. He did not give the dimensions. He states that the extremities are acute-angled and that the bone was even more transverse than it is in *T. molops*.

At the midline the hyoplastra are 77 mm. long. The usual thickness of the bones is 6 mm. Laterally, each rises into a rather broad, but thin, axillary buttress. The bridge was probably about 125 mm. long.

The hypoplastrals are 87 mm. long at the midlin . The bridge portions of the bones are mostly missing. There is no trace of the mesoplastrals, tho these doubtless were present.

The xiphiplastrals extend 82 mm. along the midline. The notch in the rear is 90 mm. wide. The borders of the hinder lobe are thin and acute. On the upper surface of the xiphiplastrals are the articular scars for the pubes and the ischia. The scars for the latter are mammiform, 17 mm. long and 11 mm. wide, and are sharply ridged and cleft. The pubic scars are somewhat elevated, 40 mm. long, 9 mm. wide, and rough.

The arrangement of the scutes of the anterior lobe can not be wholly determined. On the epiplastra appear a pair possibly coalesct at the midline, the gulars. There was probably an intergular on the entoplastron. The sulci that separated the humerals from the pectorals is not seen. The latter scutes crost the plastron about 18 mm. in front of the hyohypoplastral suture. The abdominals are 40 mm. wide at the midline; the femorals, 90 mm.; the anals, 60 mm.

Cope described limb bones which he regarded as two humeri and a small part of the proximal end of femur, but it is quite certain that what he called humeri are femora. The right femur lacks the fibular process and the distal end. Of the left femur there is the distal end. These bones agree closely with those of *Hydromedusa*, except that the tibial process extends down farther on the shaft. Cope estimates from these bones that the length was 97 mm. It was probably 10 mm. shorter. What seems to be the head of a humerus is too imperfect for definite conclusions.

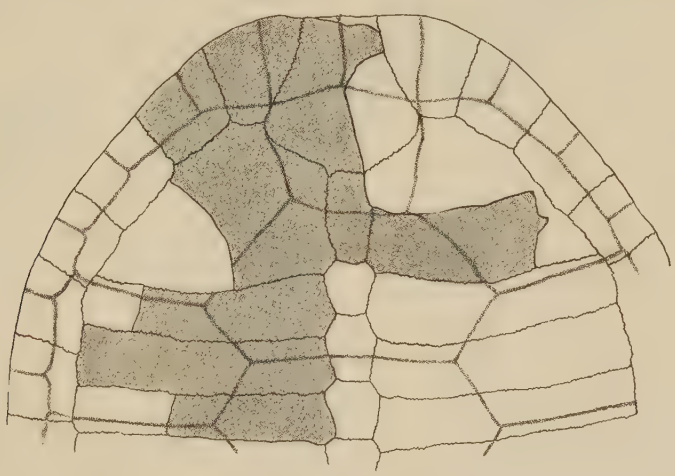


FIG. 103.—*Taphrosphys leslianus*. Anterior half of carapace of type. $\times\frac{1}{3}$. Known bones shown by stippled areas.

Taphrosphys leslianus Cope.

Text-figs. 103–106.

Taphrosphys leslianus, COPE, Ext. Batrach., Reptilia, Aves N. A., 1870, pp. 159, 166; Vert. Cret. Form. West, 1875, p. 264.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.
Prochonias leslianus, COPE, Ext. Batrach., etc., p. 165, line 14.

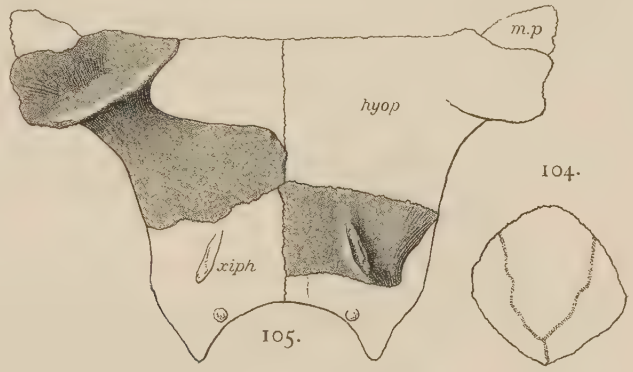
The present species is, up to this time, known from only a single specimen, Cope's type, No. 1467, of the American Museum of Natural History. This specimen has not, until this time, been figured. In his description of the specimen Cope did not state the locality or the level from which it had been derived; but his label accompanying the specimen informs us that it was found at Hornersville, New Jersey. This is in Monmouth County. In his Cretaceous Vertebrata, page 264, he informs us that it belongs to "Greensand No. 5;" so called because he regarded the uppermost bed of Cretaceous greensand as representing the Fox Hills group.

The type specimen consists of the left side of the nuchal, the first and second left peripherals, a posterior peripheral, a part of both costals of the first pair, the whole of the third

costal of the left side, parts of the second and the fourth left costals, the distal end of the fifth right costal, the entoplastron, the left hypoplastron, and a portion of the right xiphiplastron.

The species was one of relatively small size, with a deprest carapace (fig. 103), probably about 260 mm. long. The carapace is thin, the first costal being 6 mm. thick at the center; the fourth at its sutural border, 5 mm. thick. The first neural has a length of 35 mm. and a width of 18 mm.; the second, a length of 20 mm. and a width of 24 mm. The next two were somewhat longer. The broader end of each was in front, as in the genus generally. The nuchal bone was relatively long and narrow, the length being close to 67 mm., the width close to 60 mm. The width in front was only 28 mm. This bone resembles closely that of *Hydromedusa*. Its anterior border was thin and acute.

The first costal bone is 62 mm. wide fore and aft, and 75 mm. long and 6 mm. thick posteriorly. On its inferior surface at the distal end is an excavation for the axillary buttress. This rises 30 mm. above the lower end of the bone and is 9 mm. wide. The third costal is 21 mm. wide and 105 mm. long. The right fifth is 33 mm. wide distally. On its inner surface, near the distal end, is an excavation for the inguinal buttress, 33 mm. long and 7 mm. wide. The first and the second, and probably all the other costals articulated with the peripheral bones. The rib-heads were moderately developt.



FIGS. 104 AND 105.—*Taphrosphys leslianus*. Portions of type.

104. Entoplastron. ×⅔. 105. Portions of rear of plastron. ×⅓.
Known bones shown by stippling.

The first peripheral has a length of 42 mm. along the free border, and rises from this a distance of 49 mm. The second is 37 mm. along the free border and 33 mm. high. The free border of the first is acute; that of the second, subacute. The upper surface of each is convex in all directions. The thickness of the hinder end of the second peripheral is 8 mm. A posterior peripheral is 35 mm. long. It flares upward toward the free border. The latter is acute.

The surface of the carapace is smooth, but there appears everywhere a rather indistinct reticulation of grooves, which are narrower than the inclosed spaces.

The sulci are shallow but not difficult to trace. There is no nuchal scute. The first marginals join at the midline a distance of about 30 mm. The sulcus between the first and second marginals is 38 mm. long; that between the second and the third, 22 mm. Posteriorly the marginals rose rather high on the peripherals. The intermarginal sulci are nearer the anterior ends of the peripherals. The vertebral scutes have the dimensions given in the accompanying table.

Vertebral.	Length.	Width.
1	48	64
2	55	115
3	..	115

The entoplastron (fig. 104) is diamond-shaped, with rounded angles. The length is 30 mm.; the width, 31 mm.; the thickness, 3.5 mm. No other part of the anterior lobe is present.

A considerable portion of the left hypoplastron is preserved (fig. 105). The hyoplastral border makes an angle of about 60° with the free border of the hinder lobe and a right angle with the median border, so far as the latter is represented. Cope appeared to think that the

mesoplastron continued to the midline. This is not probable. The mesoplastron evidently extended inward only to the change in the direction of the anterior border of the hypoplastron; that is about one-third the distance from the peripherals to the midline.

The inguinal buttress is prominent, but thin. The hinder lobe narrowed rapidly, so that, while about 150 mm. wide at the inguinal notch, it was only about 120 mm. at the hypo-xiphiplastral suture. The thickness of the bone behind the inguinal notch is 4 mm. Only a fragment of the right xiphiplastral is preserved. It extends from the midline to the free border along the anterior end; backward to behind the scar for the pubis. The free border was acute. The ischiadic scar is elevated, 28 mm. long, and 11 mm. wide.

The surface of the plastral bones shows no sculpture. On the entoplastron may be traced sulci bounding laterally and posteriorly the intergular scute. Its anterior boundary can not be made out. On the xiphiplastron is seen the femoro-anal sulcus, 18 mm. behind the front border at the midline; 26 mm. toward the free border.

No. 1471 of the American Museum of Natural History is referred provisionally to this species. The specimen was one of the Cope collection and accompanied another specimen that was labeled as coming from Barnesboro, Gloucester County, New Jersey. Without doubt it came from the Upper Cretaceous. It consists of the right epiplastron (fig. 106), a part of the left epiplastron, a portion of the left hyoplastron, a part of the left hypoplastron, and a few other fragments. The individual was nearly as large as the type of *T. molops*, and therefore considerably larger than the type of *T. leslianus*. The plastral bones are thin, the thickness of the hinder end of the epiplastron being 8 mm., that of the hyoplastral border near the axilla, 9 mm. They are thinner than most of the corresponding bones of the type of *T. longinuchus*, a considerably smaller individual.

The epiplastron measures, in a straight line from the epiplastral symphysis to the hyo-epiplastral suture, 86 mm. The length of the symphysis is 20 mm.; the greatest width of the epiplastron is 37 mm. An abrupt ridge at the symphysis increases the thickness to 10 mm. The free border is subacute for a short distance on each side of the midline; elsewhere, obtuse. Most of the free border of the hyoplastron is obtuse.

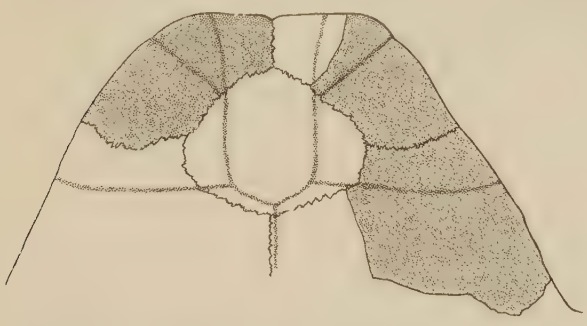


Fig. 106.—*Taphrosphys leslianus*. Anterior lobe of plastron. ×⅓. No. 1471 A. M. N. H. Known bones shown by stippling.

The entoplastron had a width of close to 70 mm.; it was probably not over 60 mm. long. The thickness of the hyoplastron immediately behind the entoplastron is 6 mm.

The fragment of hypoplastron extends along the midline 90 mm. This suture was very jagged. At a ridge on the upper surface near the front of this bone the thickness amounts to 12 mm. Posteriorly it becomes reduced to 5 mm. Of the hyohypoplastral suture there is present 110 mm. The hinder bone was somewhat overlapt by the hyoplastron.

The inferior surface of these bones shows little sculpture. Only faint traces are seen of the network of grooves present in most of the species of the genus. On the hypoplastron are seen some faint grooves running at right angles with the median longitudinal suture.

About certain of the anterior sulci there is some doubt. Those which appear to be present are represented in fig. 106. There is some doubt about the first sulcus represented on each side of the midline. Probably there ought to be a sulcus drawn across the anterior end of the entoplastron, but since this bone is missing we can not determine this. There is certainly a gulo-humeral sulcus across the epiplastron, and a humero-pectoral across the front ends of the hyoplastrals. The abdomino-femoral sulcus crost the hypoplastron 39 mm. behind the hyohypoplastral suture. Mainly on account of the thinness of these bones they are referred to *T. leslianus;* for there are no parts common to this specimen and the type. The parts of the hypoplastra present hardly coincide. No. 1471 was considerably larger.

Taphrosphys strenuus Cope.

Figs. 107–111.

Taphrosphys princeps, Cope, Cook's Geol. New Jersey, 1868 (1869), p. 735 (name only).
Taphrosphys strenuus, Cope, Ext. Batrach., Reptilia, Aves N. A., 1870, pp. 157, 166-B; Vert. Cret. Form. West, 1875, p. 264; Kerr's Report Geol. Surv. N. C., 1875, Append. B, p. 34; Amer. Naturalist, XII, 1878, p. 128.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 439.
Prochonias strenuus, Cope, Amer. Naturalist, III, 1869, pp. 89, 90; Ext. Batrach., etc., pp. 159, 167.
Prochonias princeps, Cope, Amer. Naturalist, III, 1869, p. 89; Ext. Batrach., etc., pp. 160, 167, line 44.

Altho the present species had been previously mentioned, the earliest description of it is found in Cope's monograph on the Extinct Batrachia, Reptilia, and Aves of North America, page 166-B, issued in April, 1870. Here Cope states that he had in his possession 3 specimens. Only one of these, the second mentioned by him, has been found in his collection in the American Museum of Natural History. This has the number 1126. It appears that the first specimen mentioned by him had been intended as the type of the species, while the one now numbered 1126 had been intended as the type of his species *princeps*. Before the description of the latter was printed it appears that he concluded to abandon it. Cope's description of *T. strenuus* bears evidences of imperfect revision. The second specimen, number 1126, is labeled by Cope as having been obtained from the West Jersey Marl Company's pits at Barnesboro, Gloucester County, New Jersey. The level is the Upper Cretaceous. The remains are much broken, consisting of about 75 pieces; and so many parts are missing that it is impossible to determine the exact position of many of those which remain. Of the neurals none is preserved. A few fragments of the costals remain. One, probably the fragment

Fig. 107.—*Taphrosphys strenuus*. Anterior lobe of plastron. ×½. No. 1126 A. M. N. H. Known portions shown by stippled areas.

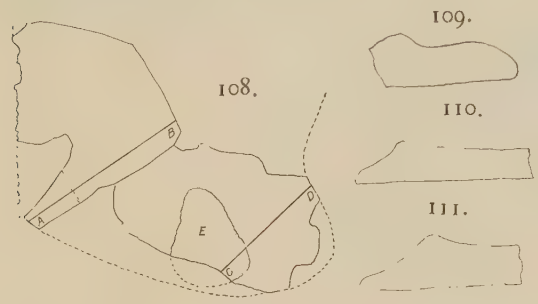
whose width and thickness are given by Cope, is 91 mm. long, 57 mm. wide, and 10 mm. thick. The rib scarcely shows on the inferior surface. The upper surface presents a network of shallow grooves at one end, but at the other the grooves inosculate but little and run nearly parallel with the sutural borders. Cope states that the peripherals are rough from the reticulate sculpture. A fragment of what is believed to be an anterior peripheral shows a close network of grooves. The greatest thickness of this bone is 21 mm. Its free border is obtuse.

Large portions of the plastron are preserved. The bones are thick and heavy. Pieces which belong at the crossings of the sutures measure in thickness about 18 mm., increasing in places to 20 mm. As in other species of the genus, the transverse sutural faces are oblique to the upper and lower surfaces of the plastron, so that the hyoplastron overlapt somewhat the hypoplastron; and the latter, the xiphiplastron. On the inferior surface the network of grooves is coarse. On one fragment is seen a narrow and shallow sulcus.

The anterior lobe of the plastron was broad and short (fig. 107). The right epiplastron is present and shows the whole of its free border, but some of the entoplastral border is broken away. To this is attacht a part of the free border of the hyoplastron. The width of the lobe at the hyoepiplastral suture was close to 300 mm. The front of the lobe was concave for a considerable distance on each side the midline. The fragment of hyoplastron is 18 mm. thick, but it thins to the subacute free border. On the epiplastron the free border becomes obtuse, the thickened part of the bone coming nearer the edge than on the hypoplastron. At the epiplastral symphysis the bone rather suddenly thickens to 22 mm.

The entoplastron must have been unusually large. Its anterior end approacht within 32 mm. of the anterior border. The anterior angle was slightly greater than 100°. The sides bounding this angle were approximately 130 mm. long. The width must have been about 160 mm. The inferior surface of the epiplastron displays an obscure reticulation, but the hypoplastron is smooth.

There are present 2 fragments of the right xiphiplastron. One of these is the hinder angle and bears the ischiadic articulation; the other shows the bottom of the great notch at the rear and a part of the median suture. These fragments join and are represented by fig. 108. The angular extremity had a very obtuse free border. A short distance from the edge the thickness is 17 mm. The ischiadic articulatory (fig. 108, *E*) surface is elevated and about 40 mm. long and 24 mm. wide. It is now much eroded. In front of this articulation the thickness is 13 mm. The median longitudinal suture is coarse and jagged. Fig. 109 represents a section across the hinder outer angle along the line *CD* of fig. 112. Fig. 110 is a section along the line *AB* of fig. 108. The posterior notch was about 180 mm. wide and relatively shallow. It appears to differ much from the notch in other species of the genus.



FIGS. 108–111.—*Taphrosphys strenuus*. ×⅓. No. 1126 A. M. N. H.

108. Right xiphiplastron, upper surface. *AB*, line of section represented by figure 110; *CD*, line of section represented by figure 109; *E*, ischiadic articulation.
109. Section along line *CD* of figure 108.
110. Section along line *AB* of figure 108.
111. Section at hypoxiphiplastral suture.

While the free border of the extremity of the xiphiplastron is very obtuse, more anteriorly it becomes acute. Fig. 111 is a section at the hypoxiphiplastral suture.

Cope described a bone which he regarded as the proximal end of the femur. With little or no doubt the bone is the left humerus. It presents close resemblances to the corresponding bone of *Chelydra*, the radial and ulnar processes, however, not being so thin as in the latter genus. Cope also described as a coracoid a bone which certainly belongs to the pelvis, having, as Cope states, 2 sutural faces and 1 cotyloid face.

Taphrosphys molops Cope.

Figs. 112–120.

Taphrosphys molops, COPE, Cook's Geol. New Jersey, 1868 (1869), p. 735 (name only); Amer. Naturalist, III, 1869, p. 89; Proc. Amer. Philos. Soc., XI, 1870, p. 274; Ext. Batrach., Reptilia, Aves N. A., 1870, pp. 158, 159, plate vii, fig. 16, text-figs. 43, 44; Vert. Cret. Form. West, 1875, p. 263.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.
Taphrosphys molops var. *enodis*, COPE, Ext. Batrach., etc., p. 162.
Prochonias enodis, COPE, Ext. Batrach., etc., pp. 158, 160.
Bothremys (*Taphrosphys*) *molops*, ZITTEL, Handbuch Palæontologie, 1889, p. 547.

Of this species Cope had a number of specimens, none wholly complete, most of them very incomplete. The one which presented large portions of the carapace and the plastron had been obtained from the upper bed of Cretaceous greensand, at Barnesboro, Gloucester County, New Jersey. This specimen is now in the American Museum of Natural History and has the number 1472. Portions were figured by Cope, and it seems proper to regard it as the type of the species. It is probable that the description of a specimen from Hornerstown appeared a short time before the detailed description given in the Extinct Batrachia, etc.; but that earlier description is not one that would enable us to determine the species, no part was figured, and the specimen was not intended by Cope to stand as the type.

Of the carapace (fig. 112) Cope figured the nuchal and the right and left first peripherals. Portions of all these bones are now missing. The anterior outline of the carapace was rounded as in *T. longinuchus*, and the free border was acute. The shell appears to have been of only moderate convexity. The width of the nuchal anteriorly was 50 mm.; its greatest width, close to 115 mm.; its length was probably about 115 mm. Its proportions were therefore as in *T.*

longinuchus. From the acute edge the bone thickens, at first rapidly, then gradually, to 12 mm., at the middle of the length. The first peripheral has an extent of 82 mm. along the free border, and 80 mm. from this to the hinder border. Its thickness is about that of the nuchal. The second peripheral measures 65 mm. along the free border. The edge is acute.

None of the hinder peripherals is present, but there are parts of two from the bridge region. One of these is 65 mm. long and presents 2 faces, which meet at a right angle along an

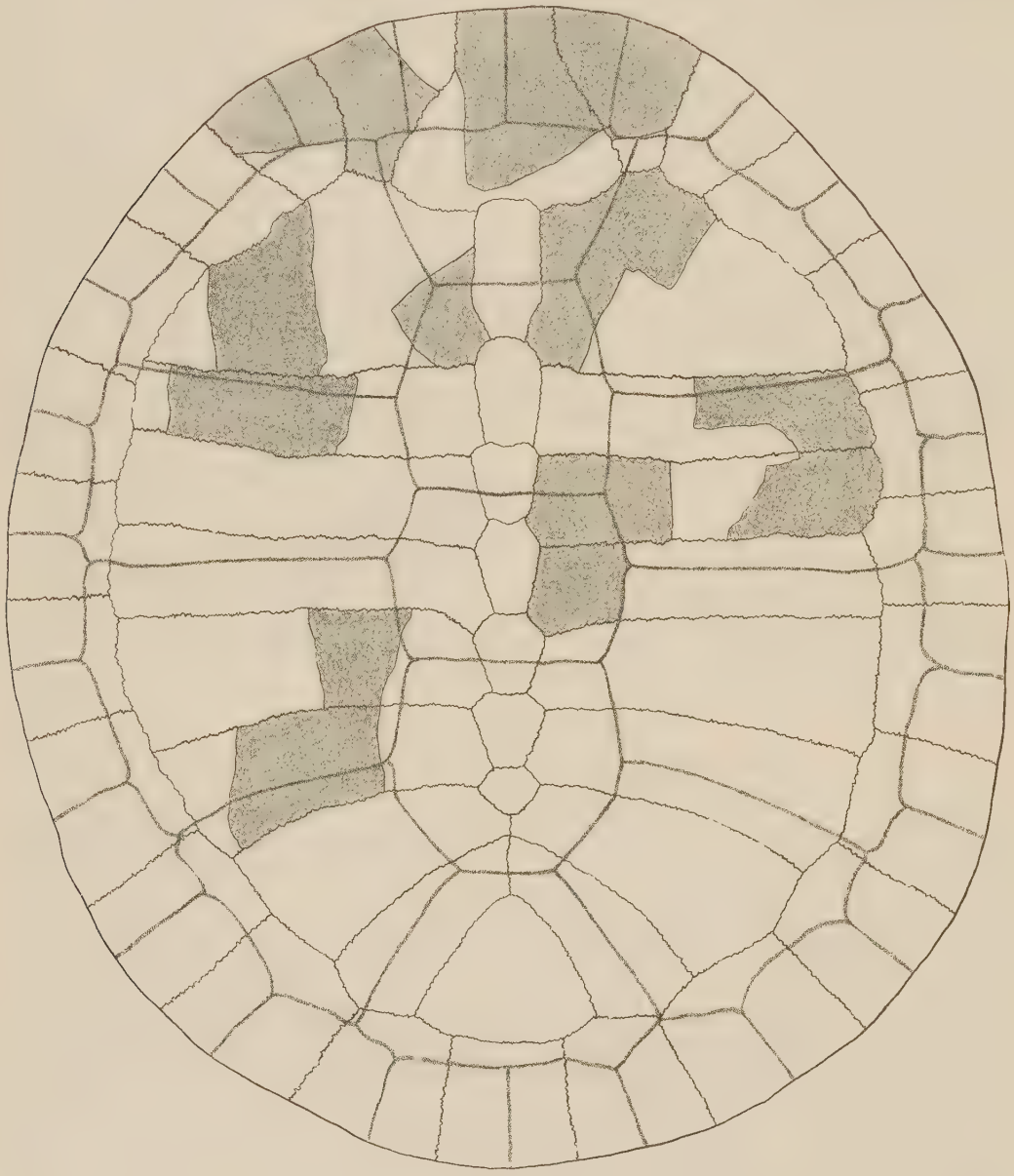
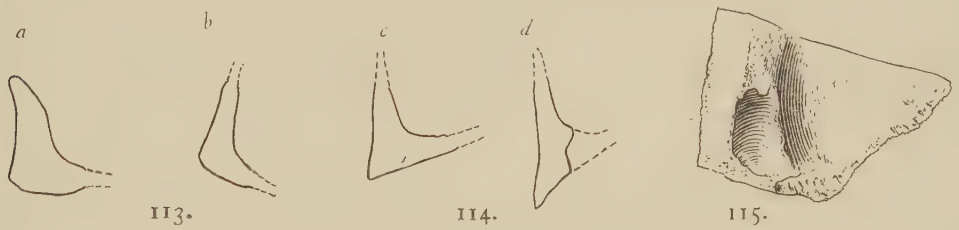


FIG. 112.—*Taphrosphys molops*. Restoration of carapace of type. $\times\frac{1}{3}$. No. 1472 A. M. N. H. Known portions represented by stippled areas.

obtuse lateral carina. Fig. 113 presents sections of the ends of this bone, *a* showing the anterior end, *b*, the posterior. A sulcus crosses both faces a little nearer the thicker end. The width of one face, probably that parallel with the plastron, is 43 mm. The other peripheral presents 2 faces meeting at an acute angle. Fig. 114 shows sections of the ends of this bone, *c* being the anterior end, *d*, the posterior. The length of the bone is 60 mm. It seems quite certain that

the peripheral with the obtuse carina is the more anterior, the one with the acute carina belonging near the inguinal notch.

Portions of the right and left first costals are present. These fragments show that these bones had an antero-posterior width of about 110 mm. The thickness at the neural border is between 9 mm. and 10 mm. On the inferior side of the bone is seen the base of the rib-head; in front of this a sharp ridge corresponding to the first rib. Each of the first costals articulated with four peripherals. A ridge proceeding from the rib-head becomes, toward the peripheral border, high and broad. In this is excavated a large pit, 20 mm. wide and rising about 50 mm.



FIGS. 113–115.—*Taphrosphys molops*. $\times\frac{1}{3}$. No. 1472 A. M. N. H.

113. Sections of a bridge peripheral. *a*, anterior end; *b*, posterior end.
114. Sections of another peripheral of bridge. *c*, anterior end; *d*, posterior end.
115. First costal, inner surface. Shows axillary pit.

above the lower border of the costal (fig. 115). This is for the reception of the axillary buttress. Its upper end is much the deeper.

There are fragments of the second, third, fourth, fifth, and sixth costals. These are represented in the restoration (fig. 112). From the proximal end of costals three and four we get an idea of the forms of neurals, but only approximate information regarding their widths. The third costal is 12 mm. thick at the neural border but only 6 mm. at the distal end. The fifth and the sixth costals are wider than those preceding them, as in *T. longinuchus*.

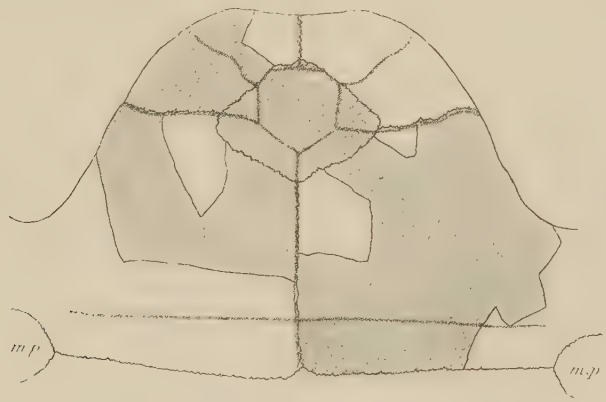


FIG. 116.—*Taphrosphys molops*. Anterior half of plastron of type. $\times\frac{1}{4}$.
Known portions stippled. *m.p*, mesoplastron.

The upper surface of the nuchal and the anterior peripherals is rather strongly sculptured with a network of grooves. The interspaces vary greatly in form and size, few being less than 5 mm. in diameter. Of the bridge peripherals one face is distinctly sculptured, the other obsoletely so. The sculpture on the costals is distinct, but usually not so strongly exprest as on the nuchal. The deepest furrows are mostly nearly parallel with the long axis of the costal.

The sulci are shallow but distinct. There is no nuchal scute. The sulcus between the first marginals is 58 mm. long. Each measures 66 mm. along the free border. The second marginals had an equal extent along the free border. The width at the anterior end is 60 mm.; at the distal end, 40 mm.

The first vertebral scute had a length of about 90 mm., a width of about 140 mm. in front and of about 80 mm. behind. The approximate proportions of the next three are shown in the restoration.

Cope figured (Ext. Batr.,Rept., etc., p.160, fig. 43) a considerable part of the anterior lobe of the plastron. Another portion of the same specimen has been found, the border of the left axillary region, and this is included in fig. 116. This specimen suffices to give us a clear idea of the form of the anterior half of the plastron. This lobe had a length of about 135 mm. and a width of about 260 mm. It was rounded in front, with a slight median concavity. The free edges are obtuse, except at the union of the epiplastrals with the hyoplastrals. The thickness is everywhere close to 10 mm. The entoplastron was diamond-shaped, 65 mm. long and 86 mm. wide. The suture of the hyoplastron with the hypoplastron was oblique to the surfaces of the bones, so that the hyoplastron overlaps the hypoplastron somewhat. A portion of the axillary region is preserved. The base of the buttress did not extend far within the free border of the anterior lobe.

It is unfortunate that the epiplastron is not complete to the midline, for we are left in some doubt regarding the more anterior scutes. An intergular occupied a large part of the entoplastron. Cope represented this as overlapping some distance on the epiplastrals, but it seems to the writer that a sulcus crosses the entoplastron close to its anterior border. Probably the gulars met, possibly coalesct, at the midline, in front of the intergular. The humerals occupied the hinder half of each of the epiplastra. In some specimens of this genus there seems to be a scute cut off from the inner end of each gular. Such a scute, or such scutes, would be without name. Better specimens are required to settle this matter. The arrangement of the scutes in this region appears to resemble that of *Chelodina*. The pectorals measure 87 mm. along the midline; the abdominals occupy the posterior 26 mm. of the hyoplastra.

Cope presents a figure of the hinder half of the plastron of this specimen. It is difficult to determine just how much of that part of the plastron was in his hands. At present there is with the specimen only a fragment of the left inguinal region, a fragment of the left xiphiplastron, and the hinder angle of the right xiphiplastron. The latter is marked in Cope's figure with the letters *Is*. The fragment of the inguinal region extends forward to the suture with some bone, probably the mesoplastron. On the upper surface about 40 mm. behind this suture is a prominent ridge, the base of the inguinal buttress. This ridge is much more strongly developt than in *T. longinuchus*.

The base of the xiphiplastron presents a coarse suture with the hypoplastron. The free border of the bone is acute. From the edge the bone thickens to 12 mm. On the upper surface of this bone is a part of the much elevated and rough articulating surface for the pubis. On the hinder angle of the xiphiplastron is the circular elevated and rough surface for articulation with the ischium. The notch in the rear of the plastron was about 140 mm. wide.

On the anterior half of the plastron there is little evidence of sculpture. It is more conspicuous on fragments of the hinder half, where it consists of a network of grooves.

Cope mentions a specimen of this species from Hornerstown, New Jersey, which displayed the mesoplastral bones. These presented a rounded interior outline and were applied to an equal extent of the hyoplastrals and the hypoplastrals. They reacht one-third the distance toward the midline. The plastron was 10.5 inches between the inguinal notches. The specimen is now lost.

Another specimen, No. 1343 of the American Museum, an individual a little larger than the type, shows a portion of the right hyoplastron from front to rear. The length is 170 mm. Just behind the axillary buttress the posterior sutural border makes a turn forward at nearly a right angle. It appears evident that this was to receive the mesoplastron. No. 1474 of the American Museum, a part of the Cope collection of fossil reptiles, was obtained by Cope, February 22, 1871, and therefore not mentioned in his monograph of 1869 and 1870. It came from Birmingham, Burlington County, New Jersey. It furnishes, besides some fragments of costals, a large part of both hypoplastra and the complete left xiphiplastron (figs. 117, 118). The individual was of almost exactly the same size as the type. The distance along the median line, from the hyohypoplastral suture to the bottom of the notch in the rear, is 243 mm. The left hypoplastral came into contact with the right xiphiplastron, an irregularity not uncommon in the early turtles. The right hypoplastron is 115 mm. long; the left xiphiplastron, 105 mm.;

both measured at the midline. Neither hypoplastron exhibits either the inguinal region or the border for the mesoplastron.

The hyoplastron overlapt somewhat the hypoplastron, and the latter similarly overlapt the xiphiplastron. At the antero-interior angle the hypoplastra are 16 mm. thick; at the postero-interior angle, 8 mm. The whole free border of the hinder lobe is acute. The hinder notch is 135 mm. wide. and 42 mm. deep. On the upper surface of the xiphiplastron (fig. 118)

FIGS. 117–119.—*Taphrosphys molops.*

117. Hinder half of plastron seen from below. ×¼. No. 1474 A. M. N. H. Known bones inclosed by solid lines.
118. Upper surface of left xiphiplastron. ×¼. No. 1474 A. M. N. H. Shows ischiadic and pubic articulations.
119. Three neural bones. ×½. No. 1470 A. M. N. H.

are seen the circular scar for the ischium and the elongated one for the pubis. Both are elevated and furnisht with sharp ridges.

The inferior surface of this part of the plastron is rough, due partly at least to erosion.

The abdominal scutes occupy about the anterior 30 mm. of the hypoplastra. The femorals are large, measuring about 135 mm. along the midline; the anals, 75 mm.

The specimen of this species mentioned by Cope as having come from Birmingham is now No. 1129 of the American Museum. The femur supposed by Cope to belong with the specimen is missing. The remaining fragments throw no light on the species.

FIG. 120.—*Taphrosphys molops.* Portions of seventh and eighth costal bones and part of suprapygal. No. 1477 A. M. N. H.

No. 1470 of the American Museum is labeled by Cope as having been received by him "9/8, 1870," and was therefore not mentioned in his monograph. It was secured at Barnesboro. The individual was somewhat larger than the type. The nuchal bone has a length of 107 mm., a width anteriorly of 64 mm., and a maximum width of 117 mm. The notch in the midline behind, for the first neural, is only 24 mm. wide. Three neural bones (fig. 119) accompany the lot, but the exact position of none of them can be determined. None shows a crossing sulcus, and yet two of them were in contact. Figures of these are presented.

The right first costal shows a great pit for the axillary buttress. A fragment of the right fifth presents the somewhat eroded ridge and elongated pit for the inguinal buttress. The latter is 10 mm. wide. The pubic scar is 53 mm. long and 15 mm. wide, elevated and rough. The pubic scar is circular.

Cope described a specimen from Barnesboro (Ext. Batr., Rept., etc., p. 161) which is important because on it he based the distinction between his *Taphrosphys* and *Prochonias*. The specimen is No. 1477 of the American Museum. Cope states that this specimen exhibits an azygous bone in contact with the caudal marginal. As a matter of fact, all the species possess such a bone, the suprapygal, but Cope evidently meant a bone still in front of this. He states that this appeared to be the co-ossified proximal portions of the last pair of costals and that the fragment appeared to be bounded posteriorly by a continuous suture. A close examination of the region in question shows that it is identical in structure with the same region in *T. sulcatus*. A figure of the fragment is presented (fig. 120). The costals of the eighth pair meet in the midline, as usual. Behind them there is the anterior end of the suprapygal. Cope overlookt the sutures between the suprapygal and the eighth costals and the suture between the contiguous ends of the costals just mentioned. The xiphiplastron is present and shows the features described by Cope. The epiplastron lacks the outer end. On the free border, at a distance of 48 mm. from the symphysis, begins the gulo-humeral sulcus, as in the figure of the type. There appears to be no sulcus nearer the symphysis. Furthermore, no sulcus is seen running in front of the suture with the hyoplastron and toward the opposite side.

Cope described a variety *enodis* of this species. The specimen on which this was based has not been seen by the present writer. According to Cope's description the free border of the hypoplastron was of equal thickness and equally obtuse, differing thus from the typical specimens of *T. molops*. Also the free margin of the hyoplastral was comprest and acute. It may be a distinct species.

Taphrosphys dares sp. nov.

Figs. 121–124.

No. 1127 of the American Museum of Natural History belongs to portions of a fossil turtle which is a part of the Cope collection of fossil reptiles. No label came with the specimen to tell what was its origin. The matrix adhering to the bones shows that the fossil did not come from the greensand of New Jersey. It consists of a yellowish or reddish sand in which are small flakes of mica. In his monograph of 1869 and 1870 Cope states, on page 167, that he had received some portions of a *Taphrosphys* from North Carolina, but the brief description given by him does not agree sufficiently with the specimens here numbered 1127. Cope had also seen specimens of what he regarded as *T. strenuus* from Georgia, and it appears probable that these are the ones. Further attention is given this matter below. It had evidently been Cope's intention to describe and figure these bones for he has indicated on them that they were to be numbered 1, 2, 3, and 4.

Wherever these bones were found, it is quite certain that they belong to a species hitherto undescribed, and were from the Upper Cretaceous. The lot presents the distal end of a fifth costal, probably the right, most of a right peripheral, the seventh or the eighth, the entoplastron, a large portion of the left xiphiplastron, and a fragment of the right xiphiplastron.

The fragment of costal has a length of 180 mm. and a width of 85 mm. One border has a thickness of 11 mm.; the other, of 16 mm. The thicker sutural border presents a sort of tongue, the middle layer of the bone projecting beyond the outer and the inner. The thinner sutural border has the outer and the inner layers projecting beyond the middle, so that the edge is grooved. The sutures between the costals seem therefore to have formed what carpenters call a tongue-and-groove joint. At the distal end of the costal, on the thicker side, is a rough surface which indicates that the costal was slightly overlapt by one of the peripherals.

The upper surface of this bone is smooth, but it is markt by a coarse network of shallow and thread-like grooves.

On the inferior side of this costal, nearer the thicker side, is a pit for the reception of the inguinal buttress of the plastron. This pit is excavated in the summit of a ridge, the rib proper. The pit has a length of 60 mm. and a width of 23 mm. Its upper end is placed 105 mm. above the lower border of the costal. Below it is a rough surface which probably joined a portion of the buttress. Altogether it appears that this costal belonged to the right side; in which case the thicker border was the hinder one.

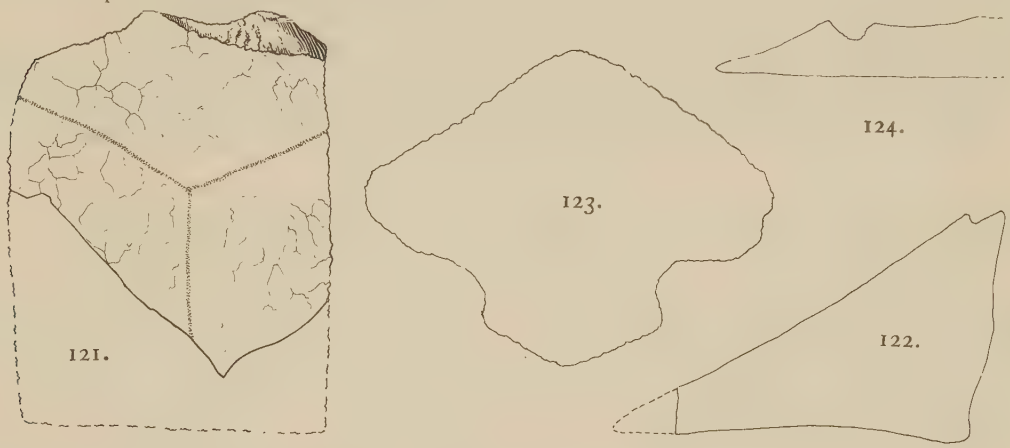
The peripheral, the seventh or the eighth of the right side, is massive (fig. 121). Unfortunately the free border is everywhere broken away, so that we can not be certain whether it

was acute or obtuse; but the probability is that it was acute. At one point it runs down to a thickness of only 11.5 mm. The fore-and-aft extent of the bone is 84 mm. The anterior border is very thick, 52 mm. at one section; and is excavated to form a part of the sternal chamber. The hinder border was not more than 15 mm. thick. The upper border joined the ends of 2 costal bones, proof that the peripheral does not belong to the axillary region of the left side.

Figure 122 is a section which is taken 20 mm. to the left of the front border. The costal that articulated with the anterior half overlapt the peripheral, but the succeeding one was overlapt by the peripheral. Satisfactory contact is not obtained between the peripheral here described and the fifth costal above described, so that their exact relations are not known.

The upper surface of the peripheral (fig. 121) is ornamented by a network of grooves similar to those of the costal, but forming a much closer reticulation. That portion of the inferior surface of the peripheral covered by horn has a still closer network of grooves. On the upper surface is seen a triradiate sulcus, which bounds a portion of the third costal scute and portions of two marginals.

Fig. 123 represents the entoplastron. Its length is 84 mm.; its width, 109 mm.; its greatest thickness, 14 mm. In the hinder border is a constriction. The outer surface presents neither sculpture nor distinct traces of sulci.



FIGS. 121–124.—*Taphrosphys dares*. Parts of the type. ×½. No. 1127 A. M. N. H.

121. Seventh or eighth peripheral, upper surface.
122. Section of peripheral of fig. 121.
123. Entoplastron
124. Section along hypoxiphiplastral suture.

The left xiphiplastron is present from the anterior border to the hinder end of the pubic scar. Its greatest width is 140 mm.; so that the hinder lobe was 280 mm. wide at the hypoxiphiplastral suture. This suture was, as seen from below, a very close one; seen from above, the adjoining bones sent coarse digitations into each other. The anterior end of the right xiphiplastron overlapt the left as much as 28 mm. The median suture was jagged above, but more even on the under side. Near the antero-median angle the bone is 17 mm. thick; the postero-median portion, 12 mm. The free border, for some distance behind the hypoxiphiplastral suture, is thin and acute. Fig. 124 is a section taken near the suture. The notch in the upper surface was filled by a digitation from the hypoplastron. On the upper surface of the bone is a large elevated area which articulated with the pubis. This articulation is much eroded. Its length was about 66 mm.; its width, about 27 mm. The lower surface of the bone shows no distinct sculpture. The femoro-anal sulcus crosses the bone, beginning at the median line about 45 mm. behind the hypoxiphiplastral suture and meeting the free border about 66 mm. behind the suture.

What appears to be a portion of the right xiphiplastron is preserved. It bears the elevated articulation for the ischium. On the left is a part of the median suture. The articulation for the ischium is about 48 mm. long and 17 mm. wide. Unless there is some error regarding this bone, the notch in the hinder lobe must have been quite different from that of the other species of the genus.

While related to *T. strenuus*, this species shows several differences. So far as the sculpture of the costals can be compared, that of *T. strenuus* consisted of more numerous and deeper grooves. The entoplastron of *T. strenuus* was much larger than that of the species here described. As shown by the section taken at the junction with the hypoplastron the xiphiplastron of *T. strenuus* thickened much more rapidly and from a less acute edge, and its hinder portion was considerably thicker than in *T. dares*.

In the collection of the Geological Survey of Georgia, at Atlanta, are some portions of a turtle which appears to belong to this species. Indeed, there are reasons for believing that they are portions of the same individual as the type bones. They are believed to have been secured in the same locality and formation as the carapace of *Peritresius ornatus;* that is, on Bonnahachee Creek, Stewart County, Georgia, in the Ripley formation, of the Upper Cretaceous.

Among the fragments is one including apparently the anterior inner angle of the hypoplastron. Sixty mm. behind the supposed hyohypoplastral suture the thickness is 26 mm. Toward the suture mentioned the thickness is reduced. Here the upper two-thirds of the bone is beveled off, showing that the hyoplastron somewhat overlapt the hypoplastron.

Another plastral fragment belongs probably to the hypoplastron behind the inguinal notch. Toward the median longitudinal suture the thickness is 16 mm. Toward the free border the thickness is much reduced, but the edge is rounded. The xiphiplastral bone in the American Museum shows that as the free border was continued backward it became acute.

Another bone appears to be the second peripheral. It is 100 mm. long on the subacute free border. The height was originally at least 82 mm. and the greatest thickness is 25 mm. The upper surface is convex from end to end, nearly plane up and down.

Named after Dares, a pugilist beaten in an encounter described in the Æneid, book v.

Taphrosphys nodosus Cope.

Taphrosphys nodosus, Cope, Ext. Batrach., Reptilia, Aves N. A., 1870, pp. 159, 167, plate i, fig. 16; Vert. Cret. Form. West, 1875, p. 264.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 438.

The type of the present species forms No. 1480 of the American Museum of Natural History. The remains are evidently those of a large, thin-shelled turtle; but these remains are meager and fragmentary. They were obtained at Hornerstown, Monmouth County, New Jersey, apparently from the uppermost bed of Cretaceous greensand. The fragments are charged with iron pyrites and are disposed to fall to pieces. Portions of costals are to be recognized and a peripheral or two.

Cope figured portions of 2 costals. His fig. 16 is from a fragment 58 mm. wide and 10 mm. thick, but the inferior layer of the bone has peeled off. Another bone which comes down to an acute edge is probably a peripheral. Its thickness at a distance of 25 mm. from the edge is 9 mm.; still farther away, it becomes 12 mm. Another piece of bone is part of a bridge peripheral, having two sculptured faces at about a right angle with each other.

The sculpture will, more than anything else, assist in the recognition of the species. This consists of pits and grooves, the latter anastamosing more or less and separating tortuous ridges and pustules. The general effect is that seen on the carapace of a coarsely sculptured trionychid. About 4 ridges are crost by a line 20 mm. long.

This species will perhaps eventually be found to belong to a genus distinct from *Taphrosphys*. Indeed, the present writer knows of no characters distinguishing it from *Peritresius ornatus* (Leidy).

Genus AMBLYPEZA nov.

A genus of pleurodirid turtles which differs from *Taphrosphys* in having the nuchal bone shorter and its front relatively broader and in having the free borders of the hinder peripherals thick and obtuse. Apparently a nuchal scute was present.

Type: *Amblypeza entellus* Hay.

Amblypeza entellus sp. nov.

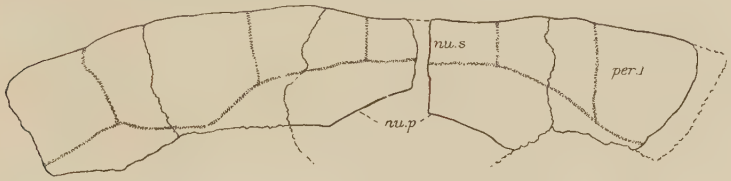
Figs. 125–132.

The type of this species is a lot of bones which belong to the collection of the Geological Survey of New Jersey, and which were loaned to the writer by the present State geologist, Dr.

Henry B. Kümmel. These bones had lain for many years in the basement of the capitol and all knowledge of their origin had been lost. Without doubt, they had been obtained from the Upper Cretaceous greensand of New Jersey.

Of this individual there are large portions preserved, but there are so many parts missing that the shell can be only partially restored. Of the carapace there were secured a considerable part of the anterior and posterior free borders and some fragments of costals. Of the plastron some important parts can be identified. The individual is estimated to have had a carapace about 700 mm. long.

Most of the nuchal bone is present (fig. 125), but, on account of the absence of a section of it, its exact width can not be determined. It was not far from 120 mm. The hinder portion is missing. The thickness near the midline in front is 13 mm.; backward the bone thins to 6 mm., while at its outer ends it is 18 mm. thick. The whole free edge is obtuse. The first peripheral (fig. 125) has a length along the free border of 83 mm., a fore-and-aft extent of 65 mm. The thickness at the suture with the second peripheral is 24 mm.; at the suture with the first costal, 8 mm. The second peripheral (fig. 125) extends 90 mm. along the free border; 70 mm. fore and aft; and is 26 mm. thick where it joined the third. Its hinder border somewhat overlapt the first costal.



125.

130.

126.

127.

129.

128.

FIGS. 125–130.—*Amblypeza entellus*. Portions of the type in State collection of New Jersey.

125. Nuchal and anterior peripherals of type. ×¼. *nu. p*, nuchal plate; *nu. s*, nuchal scute; *per. 1*, first peripheral.

126. Hinder peripherals (7 ? and 8 ?) of left side of type. ×¼.

127. Section along intermarginal sulcus of peripheral of fig. 126. ×¼.

128. Hinder peripheral. ×¼.

129. Section of peripheral of fig. 128. ×¼.

130. Inner surface of fifth costal. ×¼. Shows surface for inguinal buttress.

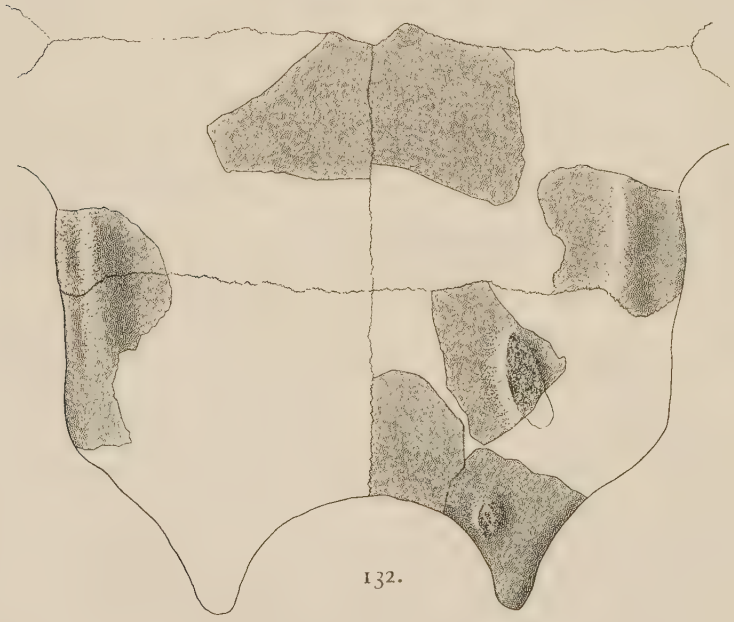
The peripherals behind the bridges were larger and thicker than those in front. One whole one and portions of two others are present. The free borders of these are thickened and very obtuse, thus contrasting strongly with the corresponding bones of *Taphrosphys*. The exact positions of these posterior peripherals can not be made out. Fig. 126 represents portions of two; and from the thickness of the bone at the left hand, 27 mm., and the height of the costo-marginal sulcus, that peripheral is believed to belong not far from the inguinal notch, being possibly the left eighth. Fig. 127 is a section taken along the intermarginal sulcus. The upper surface is convex in all directions. On the under side the horn-covered surface rose above the free border about 45 mm., descending somewhat backward. Fig. 128 represents a complete peripheral, probably the tenth of the right side; fig. 129 is a section of the anterior end. It measures 104 mm. along the free border and is 104 mm. high. The thickness near the lower border is 21 mm.; at the upper border, 13 mm. On the visceral side the surface covered with horn is 40 mm. wide anteriorly, but toward the hinder end is only 15 mm. wide. The free border is very obtuse.

A fragment of a costal has a length of 130 mm., a width of 77 mm., and a thickness of 15 mm. at the sutural border, 20 mm. through the rib. Another fragment is part of the fifth

costal (fig. 130) and shows the scar for the articulation of the inguinal buttress. This fragment is 91 mm. wide, 13 mm. thick at the sutural border, and 29 mm. thick through the ridge in which is excavated the pit for the inguinal buttress. This pit is shallow and quite different from that of any species of *Taphrosphys*.

The sculpture of the anterior peripherals is obscure, due probably to weathering; that of the hinder peripherals is more distinct. It is very different from that of *Taphrosphys dares*, and consists of a pretty close network of rather broad grooves. On the costals the intervening spaces are about as broad as the grooves and the latter run mostly parallel with the long axis of the bone.

131.



132.

FIGS. 131 AND 132.—*Amblypeza entellus*. Known parts shown by stippling.

131. Restoration of anterior lobe of plastron. $\times\frac{1}{4}$. 132. Restoration of hinder half of plastron of type. $\times\frac{1}{5}$.

Appearances indicate that there was a nuchal scute about 60 mm. wide. If this be true, the generic distinctions are strengthened. The sulci are, however, obscure. The first vertebral scute extends much nearer the front of the nuchal bone than in any species of *Taphrosphys*. At the midline the distance is only 20 mm. If there is a nuchal scute, the first marginal measures only 64 mm. along the free border of the carapace. The width at the proximal end is 24 mm.; at the distal end it has increast to 40 mm. The second marginal is 86 mm. long and 60 mm. high at the middle of the length. The marginal lying on the supposed eighth and ninth peripherals is 102 mm. long and 85 mm. high in front. On the supposed tenth peripheral the marginal descended to within 42 mm. of the lower border of the bone.

The bones of the plastron (figs. 131, 132) are so fragmentary and contacts between the pieces so rare that it is difficult to obtain measurements. The right epiplastron (fig. 131) is represented by two fragments. One of these furnishes the symphysis. This is 36 mm. long and the bone is 22 mm. thick. The hinder border was in contact with the entoplastron and is 18 mm. thick. The other fragment furnishes the hinder end of the epiplastron. There is missing probably only a few millimeters of bone between the two pieces. The epiplastron, and therefore the whole anterior lobe, was of a different form from what we see in *Taphrosphys strenuus*. From the obtuse free border of the epiplastron to the entoplastron was nearly 70 mm. If the restoration here attempted approaches correctness the entoplastron must have been at least 200 mm. wide.

The hypoplastra at their inner anterior angles are 23 mm. thick. The upper layers of the hyoplastra overlapt somewhat the hypoplastra.

Of the hinder lobe (fig. 132) there are preserved several pieces. The restoration of this lobe has been attempted and the recognized pieces of the lobe are represented by the stippled areas. On the right side is seen a fragment which extends from near the inguinal notch to the hypoxiphiplastral sulcus. The free border is rather obtuse, but becomes less so toward the suture. The upper surface rises rapidly about 40 mm. and the thickness becomes 20 mm. On the left side is a fragment presenting a portion of the hypoplastron and 110 mm. of the free border of the xiphiplastron. The border may be called subacute. Three pieces of the right xiphiplastron enable us to make out its characters; two of these form close contact and give us the hinder angle and the notch. The other piece bears on its upper surface the eroded elevated scar for articulation with the pubis. It appears to have the size and form seen in the species of *Taphrosphys*. Just outside of this surface the bone is 17 mm. thick.

The notch in the rear of the plastron had a width of about 185 mm. and a depth of about 80 mm. As the backwardly projecting angle of the xiphiplastron is approacht the bone thickens and the free border becomes very obtuse. The thickness just outside the ischiadic scar is 18 mm. The latter was elevated and rough, and apparently pear-shaped in outline.

The anterior end of the epiplastron is ornamented with a close network of grooves, which inclose spaces extremely irregular in size and form. On the hinder end of the bone the inclosed areas are larger, more elongated, and parallel with the free border of the bone. The sculpture of the rear of the plastron is similar to that just described. It is obscure on the central portions of the plastron. The sulci of the plastron are obscure. On the epiplastron there is a gulo-humeral sulcus beginning 38 mm. from the epiplastral symphysis and running backward and a little outward to the suture with the entoplastron.

This species is dedicated to Entellus, who, though old and lacking confidence, had endurance and beat his younger opponent (Virgil's Æneid, book v).

Genus NAIADOCHELYS nov.

An imperfectly known genus of Pleurodira, having the plastral surface smooth, the hinder lobe deeply and broadly notcht, and a large elevated ischial articular surface which extends to the midline.

Type: *Naiadochelys ingravata* Hay.

This genus differs from *Taphrosphys* in having the lower surface of the plastron smooth, instead of ornamented with longitudinal or anastomosing grooves, and in having a much more extensive articular surface for the ischium. At present, only the hinder half of the xiphiplastron is known.

Naiadochelys ingravata sp. nov.

Fig. 133.

This species is based on a fragment furnishing about the hinder half of a left xiphiplastron. It was collected in the year 1900, by Professor F. W. Putnam, having been brought to him by Indians, at Chaco Canyon, New Mexico. The geological formation whence it was derived is uncertain, but it was probably the Laramie, which is well developt in that region. The specimen has been transferred from the department of anthropology of the American Museum of Natural History to the department of vertebrate paleontology. The present number of the specimen is 6078. The small amount of matrix yet clinging to specimen is a yellow sandstone.

The fragment of xiphiplastron present indicates a turtle of moderate size, but furnisht with a very thick and heavy plastron. It is estimated that the plastron had a total length of 18 inches (about 460 mm.). The thickness, to the summit of the ischial articular surface, is 26 mm.; at the base of this, where it appears to be rising toward the pubic articular surface, 19 mm.; at the sutural border for union with the bone of the opposite side, 11 mm. In a specimen of *Taphrosphys molops*, No. 1474, these measurements, in the order given, are 15 mm., 10 mm., and 10 mm. This specimen is estimated to have had a plastron 21 inches long.

FIG. 133.—*Naiadochelys ingravata*. Portion of left xiphiplastron forming the type. ×½. No. 6078 A. M. N. H.

The lower surface of the bone is very flat and smooth. From the outer border the upper surface rises at first rapidly, then more slowly, to the base of the articular eminence, being thus convex. From the hinder border the upper surface rises more and more steeply, being thus concave. The articular surface for the ischium is much larger than in *Taphrosphys*. It is approximately triangular in outline, the hinder border running somewhat parallel with the hinder border of the bone, while the outer border runs parallel with the outer border of the bone and about 25 mm. distant from it. This articular surface extends mesially to the midline, differing thus from *Taphrosphys* and resembling *Hydromedusa*. The figure presented will show the form and extent of the surface. At its summit it has been somewhat eroded, and the border at the anterior angle may have been slightly extended. Where not eroded, the summit is roughened to afford attachment to the ischium. At the anterior angle of the eminence the smooth surface of the plastron at first descends, then begins to ascend, as if rising toward the articular eminence for the pubis; but no part of this is present.

Superfamily CRYPTODIRA Cope.

Thecophorous turtles having the carapace composed of neurals, costals, and peripherals. The neurals in a few cases greatly reduced. The plastron having the epiplastra in contact with the hyoplastra. Entoplastron occasionally wanting. Mesoplastrals, so far as known, never present. Temporal roof varying from complete to obsolete. Pterygoids extending backward between the basisphenoid and the quadrates. Neck bending in a sigmoid curve in a vertical plane and capable of being retracted between the scapulæ. Elements of the pelvis never suturally joined to the carapace and the plastron.

Of the Cryptodira there are 8 families and about 140 living species. Their geographical distribution is discust on page 31 and illustrated by fig. 10. To a greater extent than the members of any other superfamily the Cryptodira have been able to adapt themselves to the varying conditions of the globe. All lands, except the very coldest and the dryest, have been occupied by them. Most deserts have their species. Species inhabit forests and prairies, swamps, rivers, lakes, and the high seas. Their structure varies accordingly. By their wide geographical distribution, the number of their species, and their great differentiation of structure, the Cryptodira proclaim themselves to be the successful group among the turtles.

Geologically they reach back, according to present knowledge, to the Jurassic, being represented in the Lower Kimeridgian of Europe by species of Thalassemydidæ.

Fig. 8 represents the author's present views regarding the origin and relationships of the various families. Much remains to be determined as to these relationships.

Family THALASSEMYDIDÆ Rütimeyer.

Shell more or less incompletely ossified. Usually at least a central plastral fontanel present; often also costo-peripheral vacuities. Plastron loosely connected with the carapace; never closely sutured thereto. Limbs fitted for walking; never developt as flippers. Skull, when known, with the temporal fossæ more or less rooft over. Triturating surfaces of the jaws probably always broad. Neck short.

The present writer unites what have usually been regarded as two distinct groups of turtles. For the one there have been employed the names Thalassemydes, Thalassemydidæ, Eurysternidæ, Acichelyidæ, for the other the family names Propleuridæ, Lytolomidæ, Chelonemydidæ. The first includes mostly Jurassic genera, the second, Cretaceous and Lower Tertiary forms. Recently a number of writers have grouped the latter in the family Cheloniidæ.

The relationships of the Jurassic genera to *Osteopygis* and its kindred appear to be too close to permit the recognition of two distinct families. Much remains to be learned about the skulls of both groups; but so far as they are known, there appear to be no violent disagreements. In all, the temporal region is more or less completely rooft over by bone, and the jaws are, usually at least, fitted for crushing hard food. Nevertheless, among the Cheloniidæ, and some other families, there is the greatest variation in respect to the character of the jaws.

A remarkable resemblance is to be observed between the shells of *Aplax* (*Eurysternum*) and *Osteopygis*. Zittel's figure of the former (Palæontographica, XXIV, pl. xxvii) shows that the hyoplastron sent forward a long process that came into contact with the second peripheral, just as in *Osteopygis*. The hypoplastron, too, reacht backward to the eighth peripheral. There were, likewise, extensive fontanels enclosed by the outer ends of these plastral bones and the peripherals.

As indicating on the part of writers a recognition of close relationship between the various elements united here into one family, it may be recalled that, while the later forms have been actually incorporated with the Cheloniidæ, the Jurassic Thalassemydidæ have been regarded as the source from which our living sea-turtles have been originally derived.

Key to the Genera of Thalassemydidæ.

A. A pit in the second peripheral for the hyoplastron.
  a. At least the two anterior peripherals suturally joined with disk of carapace. Rib of eighth costal entering a pit in the tenth peripheral. Shell smooth or pitted..... *Osteopygis*
AA. No pit, so far as known, in the second peripheral for hyoplastron.
  b. Two anterior peripherals of each side articulating with the disk of the carapace.
    c. Rib of eighth costal entering pit in eleventh peripheral; the skull and lower jaw unknown..... *Catapleura*
  bb. None of the peripherals, so far as known, articulating with the disk.
    d. Lower jaw not furnisht with a beak.
      e. Symphysis of lower jaw not more than two-thirds the width of the jaws at the mental foramina..... *Lytoloma*
      ee. Symphysis three-fourths the width given..... *Erquelinnesia*
    dd. Lower jaw with beak. Skull with rooft temporal region. Choanæ in anterior half of roof of mouth. Shell not known..... *Rhetechelys*

Genus OSTEOPYGIS Cope.

Carapace including 8 pairs of costal plates and 11 pairs of peripherals, with all or only a part of the peripherals suturally articulated with the costals and the suprapygals. All the costals sending the ends of their ribs into pits of the corresponding peripherals. Five vertebral and 4 pairs of costal scutes. The nuchal scute much wider than long. Plastron relatively small; its connection with the peripherals extensive, reaching from the second to the eighth peripherals, not by close sutures. Bridge relatively narrow. Fontanels in the midline and at the ends of the hyohypoplastral suture. Inframarginal scutes present. Lower jaw with a broad and flat crushing surface; not beakt.

Type: *Osteopygis emarginatus* Cope.

This genus was establisht by Cope in 1868 (Proc. Acad. Nat. Sci. Phila., p. 147), and had for its type *O. emarginatus*. With it were included these species described at a later date: *O. sopitus*, *O. chelydrinus*, and *O. repandus*. In his next publication on the subject (Amer. Naturalist, III, 1869, p. 88) Cope subdivided the genus, setting up *Propleura* with *O. sopitus* (=*O. borealis*) as the type. The two genera were regarded as differing in this, that *Osteopygis* had all the peripherals suturally united with the disk of the carapace, while in *Propleura* only the most anterior peripherals were so joined.

When this author's work (Synopsis of the Extinct Batrachia, Reptilia, and Aves of North America) was issued in 1870, he described (pp. 105–234) both *Osteopygis* and *Propleura* as possessing 10 pairs of costal plates. In the latter genus he included only the species *sopitus*, his *repandus* being made the type of a new genus *Catapleura*, and his *chelydrinus* being referred to *Osteopygis*. Cope concluded that there were 10 pairs of costals because he found a pit, as if for a rib, in the second peripherals and supposed that he had found a pit in each of the eleventh peripherals.

In that portion of the Synopsis (pp. 235–252) which appeared in December, 1870, Cope stated that as regards *Osteopygis* the ascription to it of 10 pair of costals was an error, the last peripheral not having had a costal corresponding to it. As to *Propleura*, he adhered to his previous opinion that it possest 10 pairs of costals.

In 1875 Cope (Vert. Cret. Form. West, p. 257) had concluded that the possession by *Propleura sopita* of 10 pairs of costals was very doubtful; and this species, with *platylomus* and his new *erosus* were referred to *Osteopygis;* while *chelydrinus* went to *Catapleura*. Cope still believed that *Osteopygis* possest at least 9 pairs of costals.

In 1882 (Proc. Amer. Philos. Soc., xx, p. 144) and again in 1884 (Vert. Tert. Form. West, p. 112), Cope defined *Osteopygis* as having 10 pairs of costals and *Propleura* as having 9, statements directly opposite to those formerly made.

The correction of Cope's errors regarding the number of costals in the species of this group was made by Dr. Baur (Zool. Anzeiger, xiv, 1889, p. 42). He studied the very complete specimen which has since served Dr. Wieland as the type of *O. gibbi;* and from this he concluded that there were only 8 pairs of costals, and that the pit in the second peripheral was for the reception of a process of the hyoplastron. Baur examined also Cope's types of the species of *Osteopygis*, *Propleura*, and *Catapleura* and concluded that there were no generic differences among them.

Baur's results respecting the number of costals have been confirmed by Wieland. Nevertheless, Wieland adopts Cope's genus *Propleura*. He holds that *Propleura* differs in having costo-peripheral fontanels, conical rib-pits, and humeri grooved on their distal ends.

So far as concerns the grooving of the distal articular ends of the humeri, the present writer does not believe that enough is known about the humeri, not only of the species of the group in question but of the living species, to justify the use of the character proposed by Wieland to separate genera. Among species of *Testudo* it is found that the distal end of the humerus of many, perhaps of most, is smooth and rounded; but that of *Testudo orthopygia* has a broad trochlear groove.

Analysis of the Species of Osteopygis.

1. All the peripherals sutured to the costals (*Osteopygis*).
   - *A*. Posterior peripherals emarginate; upper borders of peripherals not notcht by the rib pits; thickness of outer end of nuchal about one-eighth its width ..... *emarginatus*
   - *AA*. Posterior peripherals not emarginate.
     - *a*. Outer end of nuchal about one-eighth the width in front; upper borders of peripherals notcht by rib-pits ..... *gibbi*
     - *aa*. Thickness of outer end of nuchal about one-sixth its width in front; upper borders of peripherals not notcht by rib-pits ..... *robustus*
2. Peripherals 3 to 10 inclusive free from the peripherals (*Propleura*).
   - *A*. Hinder peripherals angulated at end of sulcus ..... *chelydrinus*
   - *AA*. Hinder peripherals neither angulated nor emarginate.
     - *a*. Rib-pits of eighth and succeeding peripherals flattened; one face or both notcht by rib-pits. The seventh at least two-thirds as wide as long.
       - *b*. Bones thick and heavy; thickness of distal end of first peripheral in its length 3.5 times; only upper face of hinder peripherals notcht by rib-pits ... *erosus*
       - *bb*. Bones thinner, thickness of distal end of first peripheral in its length 4.4 times; both faces of upper border of hinder peripherals notcht by rib-pits ..... *borealis*
       - *bbb*. Bones thinner; thickness of first peripheral in its length 4.4 times; rib-pits of sixth and seventh peripherals flattened; both faces of peripherals notcht *platylomus*
     - *aa*. Seventh peripheral only half as wide as long ..... *sopitus*

The possession of conical rib-pits on the part of Wieland's *Propleura borealis*, if a good generic character, removes it from *Propleura*, for the type of the latter, *P. sopita*, has the pits in the hinder peripherals all flat. This statement is true as regards Leidy's type of his *Chelone sopita* and of Cope's specimen, now regarded as belonging to *Osteopygis borealis*.

There remains therefore only the presence of the costo-peripheral fontanels to separate *Propleura* from *Osteopygis*. This is one of those characters which can not be sharply defined and which may be expected to exhibit in closely related species all gradations. We can not be sure that at any time a species may not be found in which a number of the lateral peripherals are joined suturally with the costals, while others are free. Indeed, we can not be certain that in some of the described species of *Propleura* some of the lateral peripherals did not become sutured to the contiguous costals. An aged *Colpochelys kempi* has a perfectly solid carapace.

Therefore, until better characters have been proposed for the separation of *Osteopygis* and *Propleura*, the present writer prefers to employ only the former name.

Osteoygis emarginatus Cope.

Text-figs. 134–141.

Osteopygis emarginatus, Cope, Proc. Acad. Nat. Sci., 1868, p. 147 (nom. nud.); Cook's Geol. New Jersey, 1868 (1869), p. 735 (nom. nud.); Amer. Naturalist, III, 1869, p. 89; Ext. Batrach., Reptilia, Aves N. A., 1869, pp. 135, 136, 235, plate vii, fig. 3; Vert. Cret. Form. West, 1875, p. 259.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441.

Osteopygis platylomus, Cope, Ext. Batrach., etc., p. 134, fig. 39 in part.

The two specimens described by Cope under this name are in the American Museum of Natural History. Both had been discovered in the upper bed of greensand of the Upper Cretaceous, at Barnesboro, Gloucester County, New Jersey. The bones figured by Cope

Fig. 134.—*Osteopygis emarginatus*. Nuchal, right first peripheral, and portions of first costals. ×½. No. 1485 A. M. N. H.

c. p. 1, First costal bone; *nu. p*, nuchal bone; *nu. s*, nuchal scute; *per.* 1, first peripheral.

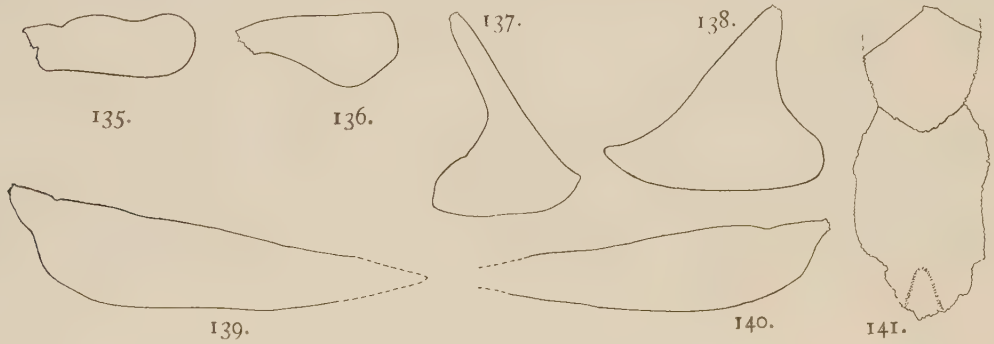
belong to the second individual described by him. This is in the American Museum and bears the number 1485.

There is, however, some doubt attached to the peripheral which furnisht Professor Cope's figure 3*c*. In his explanation of the figure, Cope says that it is the tenth of the left side. In reality, it is the eighth. He states that the eleventh peripheral of the right side is present, but it is not in the collection. It seems probable that the one he called the eleventh is the same one he called the tenth of the left side. On the bone there has at some time been written, probably

by Cope, "10 R," but the digit on the right had evidently been changed from "1" to "0" and an "L" to an "R." Finally ink lines had been drawn across these characters and "8" written near by. These changes indicate that originally Cope regarded the peripheral as the eleventh; that before he went into print he came to regard the bone as the tenth; and that at some later period he became convinct that it was the eighth. The measurements of the bone do not at all agree with those of the tenth peripheral of Cope's first specimen, but they do agree quite closely with those of the tenth of the second.

Cope (his plate vii, fig. 3*a*) has represented the nuchal, the right first peripheral, and the proximal end of both first costals. These elements are here shown in fig. 134. The free border of the nuchal and first peripherals is obtuse. At the midline, back from the free border, the thickness is 15 mm. The free border of the nuchal is 122 mm. long, in a straight line. The first peripheral is 65 mm. along the free border, and 48 mm. at right angles with this. It is 17 mm. thick at the proximal end (fig. 135) and 19 mm. at the distal (fig. 136). The upper surface is convex, with a low concavity running parallel with and just behind the free border.

The fifth left peripheral (Cope, pl. vii, fig. 3*b*, seen from the lower and inner faces) measures 77 mm. along the free border; 58 mm. on the upper face anteriorly, 60 mm. posteriorly; 52 mm. across the inner face anteriorly, 48 mm. posteriorly. The inner face contains a large pit, circular in section, for the end of the rib of the third costal. This pit occupies about one-third the length of the peripheral. The upper face is concave up and down; the lower face is convex. There was no sutural connection with the plastron, but the upper border of the upper face was suturally joined to the costal. Fig. 137 represents the anterior end of this bone; 138 the posterior end. The hinder end of the bone corresponds exactly with the anterior end of the sixth peripheral of *O. erosus*.



FIGS. 135–141.—*Osteopygis emarginatus*. Portions of shell. ×½. No. 1485 A. M. N. H.

135. Section of proximal end of first left peripheral.
136. Section of distal end of first left peripheral.
137. Anterior end of fifth left peripheral.
138. Posterior end of fifth left peripheral.
139. Anterior end of eighth left peripheral.
140. Hinder end of eighth left peripheral.
141. Neurals.

The eighth peripheral (Cope, plate vii, fig. 3*c*) is nearly plane above. The free border is mostly missing, but it had apparently about the form shown restored in Cope's figure. It was therefore rather strongly emarginated, the bottom of the emargination being at the end of the sulcus. The fore-and-aft extent of the bone at the middle of the height is 90 mm.; the height from the end of the sulcus, 100 mm. It must have been about 115 mm. high at the ends of the bone. The greatest thickness at the anterior border (fig. 139) is 24 mm.; on the posterior border (fig. 140), 22 mm. On the upper border the bone was sutured to the costal touching it. The rib-pit, mostly in the posterior half of the inner face, is 30 mm. long and is flat. It does not notch the upper face.

The first costals (fig. 134) present only their proximal halves. The greatest width fore and aft is 97 mm. The thickness in front is 12 mm.; posteriorly, 8 mm. The rib-head was prominent. In front of the ridge descending from it is a rough surface to which was articulated the rudimentary first rib.

Among other fragments of costals is the distal two-thirds of one, probably the fourth. It is possibly the one mentioned by Cope as having a width of 3 inches and 2 lines, this being the

width not far from the distal end. Its thickness is about 9 mm. It is interesting, because it shows plainly that it was articulated suturally with the contiguous peripheral. The bone is traverst longitudinally by a deep sulcus. Its surface is pitted just like a costal of *O. erosus*.

The neural figured by Cope (fig. 141) is present, as well as fragments of two others. The one figured is 55 mm. long and 36 mm. wide, deeply notcht in front, and crost behind by a transverse sulcus. It is probably one of the more posterior neurals, the seventh or the eight.

The surface of the anterior bones of the carapace is relatively smooth. The fifth peripheral is somewhat pitted, but the result probably of accident.

The nuchal scute measures 60 mm. in front, 110 mm. behind, and 25 mm. fore and aft. The first marginal measures 52 mm. along the free border and 39 mm. across the end next the second marginal.

The first vertebral had a width anteriorly of 185 mm. and a length of 82 mm. The second vertebral appears to have been about 75 mm. wide. No trace is seen of the costo-marginal sulcus on the upper border of the fifth peripheral; but doubtless on the sides of the shell the sulci followed closely the costo-peripheral sutures. On the eighth peripheral the costo-marginal sulci lie from 12 mm. to 25 mm. below the upper border of the bone.

The femur is represented by a portion of the proximal end; but the head and both trochanters are missing. The shaft has a diameter of 15 mm.

The first specimen described by Cope bears the American Museum's number 1344. It was an individual of almost exactly the same size as that regarded as the type. It furnishes the nuchal, the first right peripheral, the first, second, fourth, fifth left peripherals, the proximal half of the first left costal, some other unimportant costal fragments, a part of the right hyoplastron, a part of the right hypoplastron, and the greater part of both xiphiplastra. Cope mentions additional peripherals, but they do not accompany the bones mentioned above, and have not been recognized in the Cope collection.

That paragraph of Cope's description which occupies the upper two-fifths of page 137 of the Synopsis may be regarded as a riddle; for in it Cope constantly compares the species he is describing with itself. The explanation appears to be the following: With the specimen, in Cope's writing, is a label "*Osteopygis platylomus*, Cope, type: nr. Barnesboro, Gloucester Co., N. J." At some subsequent time two pencil lines have been drawn through "*platylomus*." There can be no doubt that the specimen is the one Cope describes as *O. emarginatus;* and there can be little doubt that the plastral bones furnisht the right hand portion of Cope's fig. 39, said to be that of the plastron of *O. platylomus*. We may suppose therefore that at one time Cope regarded this specimen as *O. platylomus* and intended to make it the type of the species; but coming to see that it was *O. emarginatus*, a portion of the manuscript was transferred to the latter species without proper changes.

The parts common to this specimen and the type of the species present no important differences. The second peripheral is 75 mm. long; 57 mm. at right angles with the free border and at the proximal end, and 21 mm. thick at the same end. The distal end has a large excavation for the process of the hyoplastron. The fourth peripheral is 67 mm. on the free border, 38 mm. across the lower face. Most of the upper face is broken away. An obtuse keel separates the upper face from the lower. The inner face of the fifth was more excavated than in the same bone of the type; and, as Cope states, the pit for the end of the rib is much smaller.

The bones belonging to this specimen which Cope appears to have employed in his fig. 39 are the hyoplastron, the hypoplastron, and xiphiplastron of the right side. The figure shows these bones and those of the type of *O. platylomus* as seen from above. A fontanel existed in the midline where it was crost by the hyohypoplastral suture. Where the plastral bones joined along the midline the sutures are coarse and jagged. The xiphiplastron sent a strong process into the outer border of the hypoplastron and the latter sent one outside of this into the xiphiplastron. Just in front of this exchange of digitations the hypoplastron is 15 mm. thick. At this level the hinder lobe of the plastron was about 165 mm. wide. On the lower side of the hypoplastron the abdomino-femoral sulcus is seen in the position represented by Cope in his figure 39. Crossing the xiphiplastron the femoro-anal sulcus falls a little further forward than represented by Cope in the figure quoted.

None of the bones of this specimen is pitted.

Osteopygis gibbi Wieland.

Plate 26, fig. 1; plate 27, figs. 1, 2; text-figs. 142–146.

Osteopygis gibbi, WIELAND, Amer. Jour. Sci. (4), XVII, 1904, p. 118, plates v–viii and text-figs. 3–7.

The type of this species is No. 783 of the Marsh collection of Yale University. It was obtained from the upper bed of Cretaceous greensand, at Barnesboro, Gloucester County, New Jersey, in 1870. It was originally studied by Dr. George Baur (Zool. Anzeiger, XII, 1889, p. 42), who determined from it that Cope had been in error when he stated that the genus *Osteopygis* possest 10 pairs of costal plates. Fig. 1, plate 26, is reproduced from a drawing prepared under Baur's directions and shows the nuchal, the peripherals, and the pygal as seen from below. In 1904 the specimen was fully prepared and the parts put together under the direction of Dr. Wieland. A number of the figures made by Dr. Wieland are here reproduced.

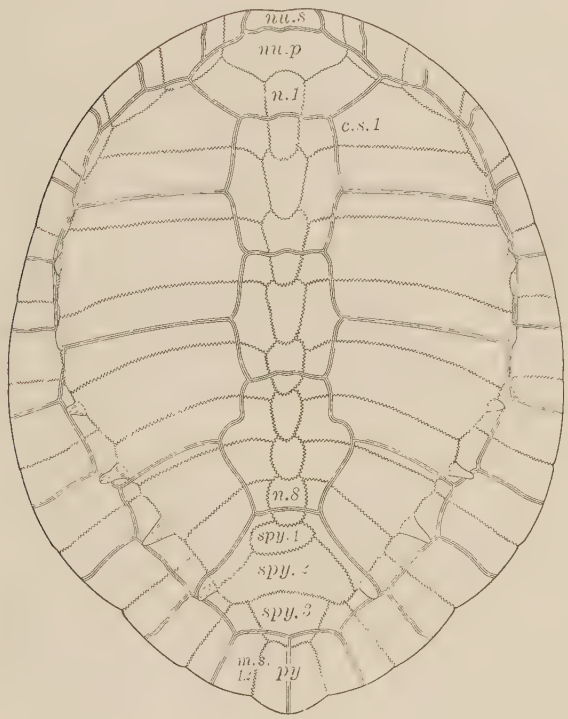


FIG. 142.—*Osteopygis gibbi*. Carapace of type. ×⅛.

c.s. 1, first costal bone; *m.s.* 12, twelfth marginal scute; *n.* 1, first neural; *n.* 8, eighth neural; *nu.p*, nuchal bone; *nu.s*, nuchal scute; *py*, pygal; *spy.* 1, *spy.* 2, *spy.* 3, suprapygals.

The specimen is the most complete that is known of any species of the family and it serves to give us a clear idea of the form and the constituents of the shell. It will be observed that the outline of the carapace as restored by Dr. Baur (plate 26, fig. 1) differs from that as restored by Wieland (text-fig. 142). Since, however, Dr. Wieland fitted the costals to one another and to the peripherals, and brought the plastron into relation with the carapace, which Baur did not do, it is quite certain that the later restoration is the more accurate one. It can hardly be wrong except in small details. Fig. 143 shows the shell from the side.

In form the carapace is elongated oval, rounded in front and somewhat pointed behind. It is somewhat deprest and especially the hinder peripherals look more upward than outward. The length in a straight line is given as 690 mm.; the extreme width, as about 580 mm. The nuchal bone is 127 mm. wide in front and has a maximum width of 145 mm. Its length is 75 mm. The dimensions of the neural bones are shown in the table.

The eighth neural is apparently followed by a small first suprapygal. This is succeeded by an irregularly shaped second suprapygal, 60 mm. long and 162 mm. wide. Behind this comes the posterior suprapygal, which has a length of 60 mm. and a width of 97 mm.

All the peripherals are suturally articulated with the contiguous ends of costal bones, except the eleventh, which articulates with the suprapygals The peripherals, except the first, second,

Neural.	Length.	Width.
1	95	41
2	65	47
3	65	47
4	65	43
5	50±	37
6	45±	33
7	45±	30
8	65±	38±

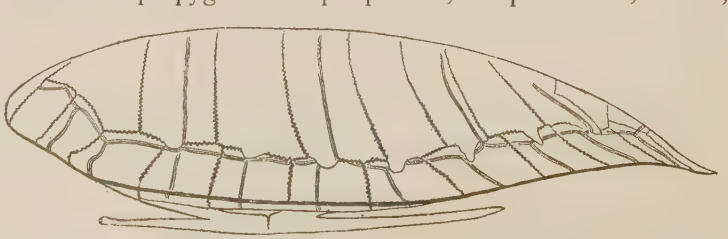


FIG. 143.—*Osteopygis gibbi*. Shell from left side. ×⅛.

and the eleventh, have each a pit in the inner face to receive the end of a rib extending beyond the costal plate. In the hinder peripherals these pits are flattened; also they produce notches in the upper face of a number of the hinder peripherals, as they do in *O. borealis*. This deficiency in the upper wall of some of the pits marks one difference between this species and *O. emarginatus*, the type of the genus. The inner face of the second peripheral has a large pit for the reception of the outer anterior extension of the hyoplastron. The inner face of the third, fourth, fifth, sixth, and seventh peripherals is broad and longitudinally excavated. These bones have thus three borders, the outer, or free border; the upper border, which articulates with the costals; and the inferior border, which comes into contact with the plastron. In the anterior end of the eighth there is a cavity into which the outer posterior process of the hypoplastron projects. The inner face of the peripherals behind the eighth becomes narrow and curves into the lower face. Thus, these hinder peripherals are thin and wedge-shaped. The dimensions of the peripherals are shown in the table herewith.

Peripheral.	Length.	Width.		Thickness.
		Upper face.	Lower face.	
1	79	60	..	17
2	82	60	..	21
3	75	61	..	..
4	76	60	..	..
5	80	64	42	..
6	85	62	41	..
7	92	81	..	..
8	95	105	..	26
9	93	105	..	14
10	90	111	..	14
11	83	110	..	..

The acute free border of the hinder peripherals may be traced forward on the more anterior ones, where it forms a keel separating the upper face from the lower. The peripherals, from the seventh to the eleventh inclusive, are slightly concave on the upper surface.

The pygal bone measures about 85 mm. along the free border and has a height of about 75 mm.

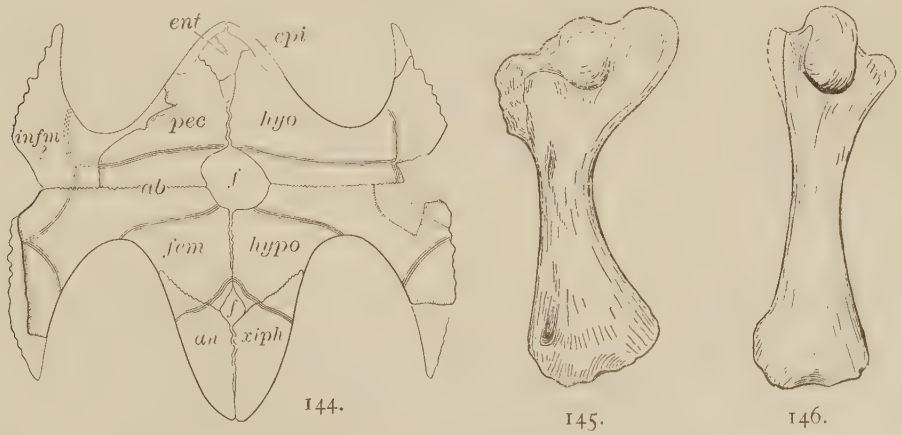
Vertebral.	Length.	Width.
1	110	210
2	140	120
3	133	115
4	142	135
5	148	180

The sulci between the various scutes of the carapace are rather deeply sunken. The dimensions of the vertebral scutes are given in the table.

The hinder border of the fifth lies on the posterior suprapygal. The supracaudals join along the midline a distance of 70 mm. and each is 40 mm. wide. The costo-marginal sulci lie wholly on the peripheral bones, close to their upper margins, except at the rear, as just noted.

There are four pairs of costal scutes.

The surface of the bones of the carapace is usually smooth; but in places there appear striations, which are directed outward and backward. There are no pits.



144. 145. 146.

FIGS. 144–146.—*Osteopygis gibbi*. Plastron and limb bones of type.

144. Plastron. ×⅛. *ab*, abdominal scute; *an*, anal scute; *ent*, entoplastron; *epi*, epiplastron; *f, f*, median and posterior fontanels; *fem*, femoral scute; *hyo*, hyoplastron; *infm?*, supposed inframarginal scute; *pec*, pectoral scute; *xiph*, xiphiplastron.

145. Humerus, dorsal surface. ×⅓. 146. Femur, dorsal surface. ×⅓.

Relatively to the carapace the plastron (plate 27, fig. 2; text-fig. 144) is smaller than in *Caretta caretta*. Nevertheless, the connection between the borders of the plastron and the peripherals is more extensive than in the genus just mentioned, extending from the second to the eighth peripherals. The outer anterior prolongation of the hyoplastron reaches forward as far as does the anterior lobe, and the outer posterior prolongation of the hypoplastron extends backward nearly as far as does the hinder lobe. The hyoplastron sends a process into the second peripheral, and the hypoplastron has its hinder prolongation inserted in an excavation of the seventh and eighth peripherals. In the fourth and sixth peripherals are small pits for digitations of the plastral bones. The median longitudinal suture is a coarse one. There is a median fontanel at the crossing of the hyohypoplastral suture and the median longitudinal. On each side, at the ends of the hyohypoplastral suture, is another fontanel. A fourth is found on the median line just in front of the xiphiplastra.

The epiplastra are narrow bones which have a length of about 85 mm. and a width of 15 mm. The entoplastron is only in part preserved. It appears to have been 85 mm. long and 59 mm. wide.

The least width across the bridges is 114 mm. The hinder lobe is much reduced, leaving free play for the hinder limbs. The xiphiplastra are 185 mm. long and 55 mm. wide.

The sulci of the plastron are very obscure, but Wieland appears to have mapt them correctly. There were quite certainly inframarginals on the outer ends of the bridges. The sulcus between the gular and the humeral scutes has not been observed; nor that between the humeral and the pectoral. Wieland calls the pectoral scutes the humerals; the abdominals, the pectorals; the femorals, the ventrals; the anals, the femorals. The abdominals have a width, at the midline, of about 65 mm.; the femorals, a width of 78 mm.; the anals, a width of nearly 150 mm.

Wieland has figured the humerus (fig. 145). The total length is 145 mm.; the short diameter of the flattened shaft, 18 mm.; the long diameter, 21 mm. It resembles the humerus of *Chelydra*. The angle between the planes of the ulnar and radial crests is obtuse. The distal end of the bone is grooved, as in some species of *Emydidæ* and of *Testudinidæ*. The ectepicondylar passage is a deep perforation. The femur has a length of 150 mm., therefore is longer than the humerus. It resembles that of *Chelydra*, except that the distal end is grooved. In this respect too it differs from the femur of *O. borealis*.

Wieland has described and figured the ulna, the tibia, 2 metatarsals, and 1 cervical vertebra. Fig. 146, from Wieland, represents the femur.

This species is most nearly related to the type of the genus, *Osteopygis emarginatus* Cope. The latter differs in having the posterior peripherals emarginated on the free borders at the end of the intermarginal sulci, in not having the upper borders notcht so as to expose the end of the rib, in having a shorter first vertebral scute, and apparently in having narrower second and third vertebral scutes. The type of *O. emarginatus* is only slightly smaller than the type of *O. gibbi*, the nuchal of the former measuring along the front 122 mm.; that of the latter, 127 mm. The first vertebral scute of *O. emarginatus* is close to 82 mm. long; that of *O. gibbi*, 110 mm. The width of the second vertebral of *O. emarginatus*, at the anterior end, is close to 75 mm.; that of *O. gibbi*, about 102 mm.

Osteopygis robustus sp. nov.

Figs. 147–151.

In the American Museum of Natural History is a lot of bones which is accompanied by a label written by Professor Cope, stating that they were found at Birmingham, New Jersey, that he regarded them as belonging to *Osteopygis emarginatus*, and that he received them November 13, 1870. Those bones which can be safely regarded as belonging to one individual are the nuchal, the first and second peripherals of both sides, the tenth and eleventh peripherals of both sides, the fourth costals of both sides, the left fifth, the left seventh and the eighth, and the proximal end of the right eighth. There are also fragments of other costals of undetermined position. To this specimen is given the number 2360.

A comparison of these bones with those of the types of *O. emarginatus* and *O. gibbi* makes it evident that they belong to a hitherto undescribed species. The differences will appear as we

progress with the description. That which especially strikes one is the greater thickness of the bones here described, as compared with corresponding ones of *O. emarginatus* and *O. gibbi*. The three types are of nearly the same size. The dimensions of various bones are given in the following table. Except the length, the dimensions of each bone are taken at the anterior end. The thickness of the nuchal is taken at the midline. The columns headed by 1 belong to *O. emarginatus;* those by 2, to *O. gibbi;* those by 3, to *O. robustus*.

Element.	Length.			Height.			Thickness.		
	1	2	3	1	2	3	1	2	3
Nuchal	122	127	125	...	...	...	15	16	20
Peripheral 1	63	79	78	48	60	60	19	17	30
2		82	83	46	60	60	20	21	25
10		90	89	..	111	110	..	14	18
11		83	90	..	110	100±	..	..	19
Pygal		83	96	..	71	68	..	..	20

The nuchal bone (fig. 147) appears to have extended backward further in this than in the species with which it is compared above. The hinder portion of the bone is broken away, but the portion remaining is 80 mm. wide anteroposteriorly. The nuchal of *O. emarginatus* measured in the same place gives us 70 mm.; the nuchal of *O. gibbi* has a length of 75 mm. Fig. 148 is a section at the articulation between the nuchal and the first peripheral.

The upper border of the first peripheral, articulating with the first costal, has a thickness of 10 mm. (fig. 148). The left second peripheral lacks the hinder end; and that of the right side has the hinder end of the inner face so eroded that it does not show the pit for the hyoplastron. These peripherals articulated with the first costal. The other peripherals are missing to the ninth, and of these only unimportant fragments remain. The tenth and eleventh (fig. 149) are nearly plane above, or slightly convex. The rib-pits are flat; and that of the

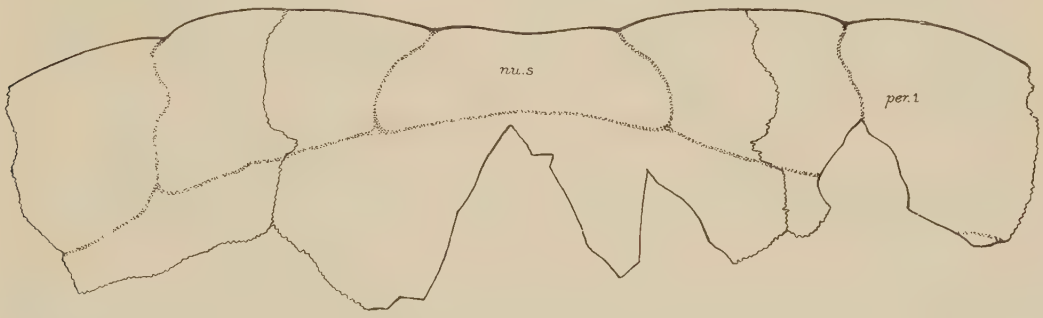


FIG. 147.—*Osteopygis robustus*. Nuchal bone and first peripheral right and left, of type. ×½.

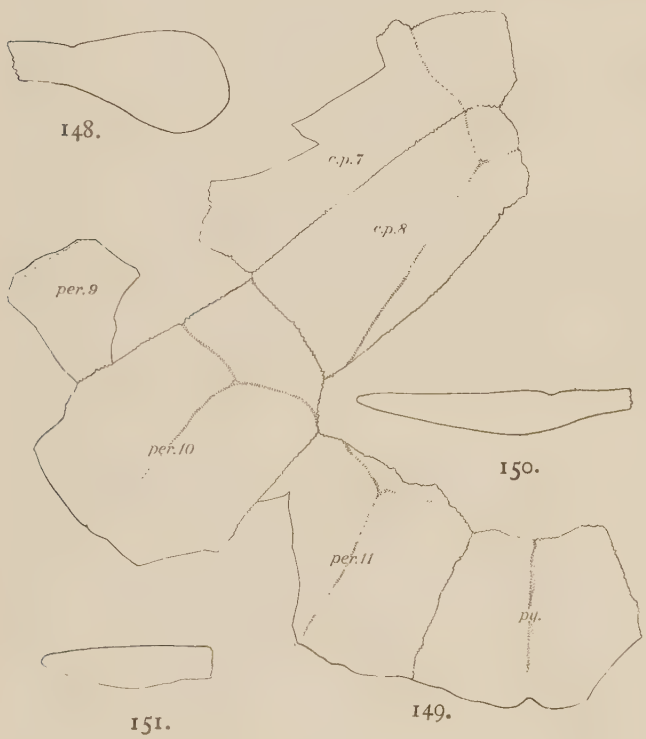
nu. s, nuchal scute; *per.* 1, first peripheral.

tenth is rooft over to the articulation with the eighth costal plate with bone 7 mm. thick. It is possible, but not probable, that the ninth peripheral had its upper border notcht by the rib-pit, as it is in the case of all the hinder peripherals of *O. gibbi*. No rib entered the eleventh peripheral. This and the pygal articulated suturally with the last suprapygal. The upper sutural border of the pygal is 13 mm. thick. The free borders of the tenth and eleventh peripherals are acute. Fig. 150 represents the front end of the tenth peripheral. There are no indications of emarginations of the free border such as are supposed to characterize *O. emarginatus*. The pygal (fig. 149) is notcht somewhat at the midline. Fig. 151 is a section thru the middle of the pygal.

There are present what are regarded as the proximal and the distal portions of the left fourth costal; the proximal end of the right fourth; the left seventh, lacking most of the front border; the left eighth entire; and the proximal end of the right eighth. These bones are all thick. Where the suture with the neurals is shown the bone is 10 mm. or 11 mm. thick. At the middle of the length of the costals the sutural edges are about 6 mm. thick. The distal ends of costals four and five were suturally joined to the corresponding peripherals; and the same is true of the seventh and the eighth. The fourth costal has a width of 62 mm. at the costo-vertebral sulcus and 70 mm. at the distal end. The end of the rib of this costal projects from near the front border of the distal end, as it appears to do, likewise, in *O. gibbi*. The width

of the fifth costal at the distal end is 77 mm. At the costo-vertebral sulcus the seventh and eighth costals (fig. 149) are each 39 mm. wide. The eighth is 47 mm. wide at the distal end. On the inferior side of the eighth costal is seen the base of the small rib-head. Behind this is the co-ossified end of the vestigial tenth rib.

The surface of the bones of the carapace is almost everywhere more or less uneven. On the nuchal and the anterior peripherals the areas occupied by the scutes are tumid, and the sulci run in deep and broad valleys. The same remarks apply to the dorsal region of the carapace, so far as represented. The sulci of the distal portions of the costals and of the hinder peripherals are deeply impressed. The upper surfaces of the hinder peripherals are more or less undulating.



FIGS. 148–151.—*Osteopygis robustus*. Costals, peripherals, and pygal of type.

148. Section at proximal end of first peripheral. ×½.
149. Right seventh and eighth costals, hinder peripherals, and pygal. ×⅛.
150. Section of anterior end of tenth peripheral. ×½.
151. Section along middle of pygal. ×½.

The nuchal scute (fig. 147) is smaller than that of either *O. emarginatus* or *O. gibbi;* its width anteriorly being 47 mm.; posteriorly, 80 mm.; its fore-and-aft extent, 24 mm. The first marginal is 62 mm. along the front; 30 mm. where it joins the nuchal; 45 mm. where it joins the second marginal. On the tenth peripheral the costo-marginal sulcus runs 30 mm. below the upper border of the bone. At the midline behind, the sulcus crosses on the hinder supra-pygal.

The anterior vertebral scute had a width of about 200 mm. On the fourth costal the costo-vertebral sulcus crosses the bone at a distance of about 44 mm. from the neural border. Estimating the width of the neural at 45 mm. the width of the third vertebral would be about 135 mm. The fourth vertebral, at the anterior border of the seventh costal, appears to have been about 100 mm. wide. That of *O. gibbi* was about 135 mm. wide. The fifth vertebral had a width posteriorly of 190 mm. Its length was close to 155 mm.

On account of the common feature of sutural union of all the peripherals with the costals, this species needs comparison only with *O. emarginatus* and *O. gibbi*, and such comparisons have already been made.

Osteopygis chelydrinus Cope.

Plate 23, figs. 4–7; plate 28, figs. 1–4; text-figs. 152–154.

Osteopygis chelydrinus, COPE, Proc. Acad. Nat. Sci. Phila. 1868, p. 147 (nom. nud.); Geol. New Jersey, Cook, 1869, Append., p. 735 (nom. nud.); Amer. Naturalist, III, 1869, p. 89; Ext. Batrach., Reptilia, Aves N. A., 1869, pp. 135, 138, plate vii, fig. 8.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441.

Catapleura chelydrina, COPE, Vert. Cret. Form. West, 1875, p. 259.

In his Synopsis of the Extinct Batrachia, Reptilia, and Aves of North America, Professor Cope stated that this species was represented by "only 10 marginal plates more or less perfect and some costals"; also that the species was referred to the genus *Osteopygis* because the

"anterior rib-bearing marginal bone has been united with the middle disk by suture." In the Vertebrata of the Cretaceous Formations of the West he says that the reference of the species to *Catapleura* is not final, "as the anterior costals and marginals are not known."

Of Cope's type only a single bone was figured, the peripheral which he regarded as doubtfully the tenth of the right side. In the Cope collection of fossil reptiles in the American Museum of Natural History this figured bone is found (plate 23, figs. 4, 5; text-fig. 152). It is accompanied by a number of other bones, some of which are markt in such a way that it is evident that Cope intended to figure them; besides other bones which probably do not belong to the species. It is evident that several of the bones belonging to the type have been lost, while it is probable that a few of other species have become mingled with it. It is certain, therefore, that our future identification of the species in new materials must depend principally on the figured peripheral. The catalog number is 1131. Cope's label shows that the type came from Barnesboro, New Jersey.

It is evident that the bone in question does not belong to the right side. Usually in the related species the pit for the rib lies nearer the hinder end of the bone and the sulcus reaches the upper border in front of the pit; but if this bone is assigned to the right side, this pit will lie nearer the front end and the sulcus will fall behind the pit. The bone appears to be the seventh of the left side. It resembles closely the seventh of a specimen of *O. borealis*, but with specific differences.

Cope has given the length and breadth of this bone as being respectively 2 inches 9.3 lines (70 mm.) and 3 inches 2 lines (80 mm.), by length meaning evidently the distance from the suture with the bone in front to that with the bone behind, and by width the distance from the costal border to the free border. These dimensions will vary somewhat with the points selected

FIGS. 152–154.—*Osteopygis chelydrinus*. Sections of peripherals of type. ×¾.

152. Section of seventh peripheral. 153. Section along intermarginal sulcus of second left peripheral. 154. Section at front of third peripheral.

on the borders. The free border of the bone originally measured at least 75 mm.; the upper border now measures 53 mm.; and the anterior border 80 mm. Cope states that these peripherals are remarkable for their shortness, but a careful comparison hardly confirms this statement. A more certain character appears to be found in the thickness of the bone. The thickness of the end regarded by the present writer as the anterior is slightly more than 23 mm.; that of the other end is 19 mm. This is considerably more than the thickness of even the eighth peripheral of any known species, regard being had for the other dimensions.

Another character has been noted by Cope, the angulation of the free border, at the end of the epidermal sulcus. The angle included between the two portions of this border is about 130°. In other species the border is nearly straight or slightly concave where met by the sulcus. Usually in turtles, when the border of the carapace is notcht, the sulcus ends at the notch. Whether or not the angulation of the border is found in all of the posterior peripherals we have now no means of determining; but in all probability all were angulated.

The pit for the extremity of the rib is elliptical in section and 29 mm. deep. The horizontal diameter is 15 mm.; the perpendicular, 11 mm.

The bone may be regarded as having three faces, an upper, a lower, and an inner. The upper is slightly concave along a line from the costal to the free border. The epidermal sulcus is broad, but rather shallow. The sulci between the marginal scutes and the adjacent costal scutes appear to have run along close to the costal border. The lower face is considerably convex along a line from the free to the costal border. On this face there is a broad shallow sulcus, corresponding to the one above. The inner face contains the rib-pit. This face is concave and irregular, with the upper portion overhanging the lower. The bone did not form a sutural connection with the border of the first costal plate.

The second peripheral of the left side (plate 23, figs. 6, 7; text-fig. 153) measures 64 mm. along the free border and has a minimum width of 45 mm. From the thin costal border the bone thickens rapidly on the lower side until a thickness of 16 mm. is attained at the proximal end of the bone and of 19 mm. at the distal end. The inner half of the lower surface is a little concave; the outer half very convex and rising to meet the upper surface. The anterior half of this face looks forward. The distal end of the lower surface is deeply excavated for the outer anterior angle of the hyoplastron. There can be little doubt, it is believed, that this is the peripheral whose length and breadth Professor Cope has given respectively as 2 inches 6 lines and 1 inch 9 lines. It was evidently suturally united with the first costal plate.

The third peripheral (plate 28, figs. 1, 2; text-fig. 154) of the right side is present. It has an extent of 61 mm. along the free margin and 42 mm. at right angles with this. It presents three faces, an upper, an inner, and a lower. The inner face is concave and is to a great extent occupied by an excavation for the reception of the rib of the first costal plate. Its width is 42 mm. where widest. It is separated from the lower face by a sharp ridge.

The upper face is nearly plane except in front where it rises to the summit of a ridge, on which it joins the lower face. A sulcus crosses this face nearer the proximal end. Its hinder border is grooved by the sulcus between the marginal and the first costal scute. The maximum width of this face is 34 mm. The lower face is quite convex vertically, the upper portion of it looking upward and forward, the remainder downward and forward. Its width is 23 mm. What distinguishes these anterior peripherals especially is the carina where the upper face meets the lower.

Accompanying the bones above described is the lower jaw of a turtle, consisting of the united dentaries (plate 28, figs. 3, 4). This has written on it, doubtless by Professor Cope, the name "chelydrinus." It is hardly conceivable that he would not have mentioned this jaw had it been present when he described the other bones. It is difficult to understand why he should have referred it to this genus and species without some good reason, when it would naturally have been placed in his genus *Lytoloma*. It is possible that he discovered after his description had been publisht that it belonged with the type of *O. chelydrinus*, yet he does not mention the lower jaw in his reference of the species to *Catapleura* in 1875; but he does give, under the genus *Osteopygis*, a description of the lower jaw, which description might have been based on the jaw now under consideration; and no other jaw is known which has been referred to *Osteopygis*. The matrix clinging to the jaw is exactly like that on the peripherals. The matter is very obscure.

This jaw resembles that of *Lytoloma angusta*, but there are at least specific differences. Figures of it are here presented. In the jaw called "chelydrinus" the outline is almost that of a semicircle whose center lies a little behind the posterior end of the symphysis and whose radius is 38 mm. In *Lytoloma angusta* the outlines of the jaw run in nearly direct lines from the front of the masseteric fossa to near the tip of the jaw. In the jaw "chelydrinus" a line joining the mental foramen, lying in the front of the left masseteric fossa, with that of the right side falls at or a little behind the posterior end of the symphysis. In the type of *Lytoloma angusta* the same line falls in front of this end of the symphysis a distance equal to one-sixth the whole length of the symphysis. In "chelydrinus" the symphysis forms 47 per cent. of the width of the jaws at the front of the masseteric fossæ; in *Lytoloma*, 58 per cent. It is quite evident, therefore, that the jaw labeled "chelydrinus" represents a species distinct from *Lytoloma angusta*. It differs fully as much from the jaw figured by Wieland under the name *Lytoloma angusta*, here described as *Lytoloma wielandi*.

Osteopygis erosus Cope.

Plate 26, fig. 2; text-figs. 155–162.

Osteopygis erosus, Cope, Vert. Cret. Form. West, 1875, p. 258.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441.

The type of Cope's *Osteopygis erosus* is now in the American Museum of Natural History and bears the number 1130. The specimen appears to have been discovered in the upper bed of Cretaceous greensand, at Barnesboro, New Jersey, in 1869. It was probably found too late for inclusion in the monograph of 1869 and was reserved for publication until 1875. The

type specimen comprises all the peripherals of the left side, except the third, fourth, fifth, and eleventh; the second, fourth, eleventh and half of the ninth of the right side; the first left costal, lacking the distal end; the distal end of the first right costal, and many fragments of other costals; two neurals and a portion of a suprapygal; some fragments of the plastron; and two vertebræ. Cope mentions five vertebræ.

An estimate, based on the dimensions of the peripherals, shows that the carapace was probably slightly shorter than that of the type of *O. gibbi;* that is, it was about 740 mm. long in a straight line.

FIG. 155.—*Osteopygis erosus.*

First and second peripherals and first costal of type. ×⅓. First peripheral at the right.

Professor Cope stated that this species is abundant in the upper bed of Cretaceous greensand at several localities in New Jersey, but the present writer knows of but one other specimen.

The nuchal bone is missing, but its form and proportions were probably similar to those of the nuchal of *O. emarginatus.* The following table presents the dimensions of the peripherals (plate 26, fig. 2; text fig. 155). The length is taken along the free border. The height is the distance at the anterior end of the bone, from the free border to the costal border. The thickness is the greatest taken at the anterior end of the peripheral. Where a definite inner face presents itself, as from peripherals 4 to 8, the thickness is replaced by the dimensions of these faces. The dimensions of the hinder end of any bone are the same as the dimensions of the front end of the succeeding bone.

Peripheral.	Length.	Height.	Thickness.	Width.	
				Lower face.	Inner face.
1	83	61	21	..	..
2	81	62	23	..	..
3	..	51	31	..	..
4	78	53	..	38	63
5	..	64	..	43	68
6	83	65±	..	57	47±
7	85	76	..	57	46
8	94	92	..	80	31
9	98±	100±	18	..	..
10	95	97	17	..	..
11	90±	105±	17	..	..

The free borders of the first (fig. 156) and second (fig. 157) peripherals are thick and obtuse. On the fourth there is a subacute, slightly upturned free edge, which may be traced forward as an obtuse keel, even to the first peripheral. On the fourth peripheral (fig. 158) the upper and the lower faces form an angle with each other greater than a right angle; but on the sixth (fig. 159) this is already less than a right angle; and more posteriorly the two faces become more nearly parallel (figs. 160, 161). The upper faces of the four anterior peripherals are irregularly convex; those of the sixth and seventh are somewhat concave; those of the others are nearly plane.

In the hinder end of the second peripheral (fig. 157) is a deep pit for the anterior prolongation of the hyoplastron. Cope thought that this pit was for the rib-end of the first costal. The pits in the greater number of the peripherals are circular in section. Those of the ninth, tenth, and eleventh are flattened. In the last-mentioned cases the pits produce notches in the upper faces of the peripherals. The anterior end of the inner face of the eighth peripheral is deeply excavated for the posterior outer angle of the hypoplastron. The inner face of the seventh is considerably excavated for the same purpose. Several shallow pits appear along the lower borders of the inner face of the sixth and seventh peripherals for digitations of the plastron. There was no pit in the eleventh peripheral. This bone had a thickness of 18 mm. where it joined the pygal.

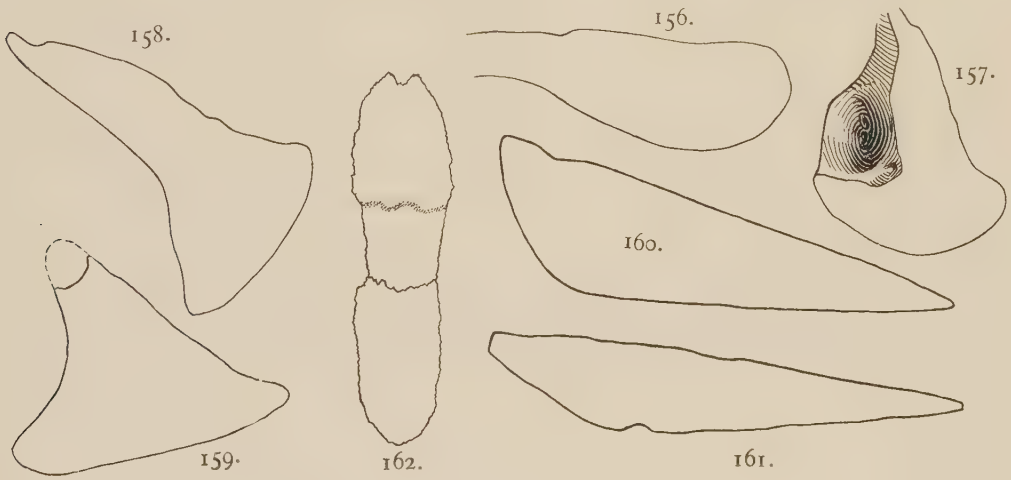
As regards the connection of the peripherals with the costals, we appear to have the following: The first and second peripherals were closely sutured with the first costal. The distal end of this costal shows that at least the anterior half of the third peripheral was sutured with it. The anterior end of the upper border of the fourth costal is smooth; the posterior two-

thirds is rough, indicating sutural union with the second costal. Probably the sixth peripheral was free from union with a costal; also the seventh. The hinder portion of the border of the eighth peripheral is rough, as if it had formed a suture with the contiguous costal. The upper borders of the succeeding two peripherals are broken away, so that we can not determine their mode of connection with the costals. The eleventh peripheral articulated suturally with the suprapygals.

The first costal bone (fig. 155) has an extreme width of 104 mm. The outer end of its rib was inserted in the third peripheral. In front, where it articulated with the nuchal, it is 10 mm. thick and the suture is beveled in a manner to show that the nuchal slightly overlapt the costal. The hinder border is 9 mm. thick. Another costal has a width of 72 mm. and a thickness of 10 mm. The rib is not conspicuous on the under side.

The two neural bones are probably the third and fourth (fig. 162). Measured along the midline the bone anterior is 84 mm. long, while the width is 42 mm. The anterior end is narrowly notcht for the reception of the preceding neural. There is no definite angle between the antero-lateral and the postero-lateral sides. The other neural is 61 mm. long and 40 mm. wide.

The sulci which mark the boundaries of the horny scutes are extremely distinct, becoming sometimes deep and broad. The outer end of the first marginal is 46 mm. wide. The second



FIGS. 156–162.—*Osteopygis erosus*. Portions of shell of type. No. 1130 A. M. N. H.

156. Section of first peripheral. ×⅔.
157. Hinder end of second peripheral. ×⅔. Shows pit for process of hyoplastron.
158. Section of fourth peripheral. ×⅔.
159. Section at anterior end of sixth peripheral. ×⅔.
160. Section at middle of length of eighth peripheral. ×⅔.
161. Hinder end of tenth peripheral. ×⅔.
162. Two neurals. ×⅓.

extends from the free border 55 mm.; the third, 41 mm. Behind this, the costo-marginal sulci run along on the upper borders of the peripherals. From the upper borders of the eleventh peripheral the sulcus crost on the last suprapygal, not coming into contact with the pygal. The first vertebral scute appears to have been as in *O. emarginatus*. Its width can not be determined.

All the bones of the carapace are more or less rough and uneven, but that which especially distinguishes them is the presence of numerous pits. These vary in size, depth, and distribution. The average diameter is about 5 mm. These pits are relatively few on the anterior portion of the carapace. They are numerous on the costals, and present commonly on the peripherals (plate 26, fig. 2).

The fragments of the plastron furnish no useful information,

Accompanying the bones are a scapula and an ilium. The upper end of the scapula and the distal end of the procoracoid process are broken off. The remainder of the bone resembles the same bone in *Caretta caretta*. The ilium is broader and flatter above than in the genus just named.

Osteopygis borealis (Wieland).

Plate 26, fig. 3; text-figs. 163–171.

Osteopygis sopita, Cope, Proc. Acad. Nat. Sci. Phila. 1868, p. 147; Vert. Cret. Form. West, 1875, p. 258.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441.

Propleura sopita, Cope, Cook's Geol. New Jersey, 1868 (1869), p. 735; Amer. Naturalist, III, 1869, p. 88; Ext. Batrach., Rept., Aves N. A., 1869, pp. 140, 235, p. vii, figs. 4–7, text-fig. 39.

Propleura borealis, Wieland, Amer. Jour. Sci., (4) XVII, 1904, p. 129, pl. ix; *ibid*, XVIII, 1904, p. 190, fig. 4.

Under *Osteopygis sopitus* the writer has presented his reasons for concluding that Cope erred when he referred to that species the specimen of *Osteopygis* which he described in his Extinct Batrachia, etc., p. 140, plate vii, figs. 4–7.

The type of Wieland's *Propleura borealis* is No. 778 of the Marsh collection, in the Yale University museum. It was obtained in 1870, from the upper bed of greensand, near Horners-

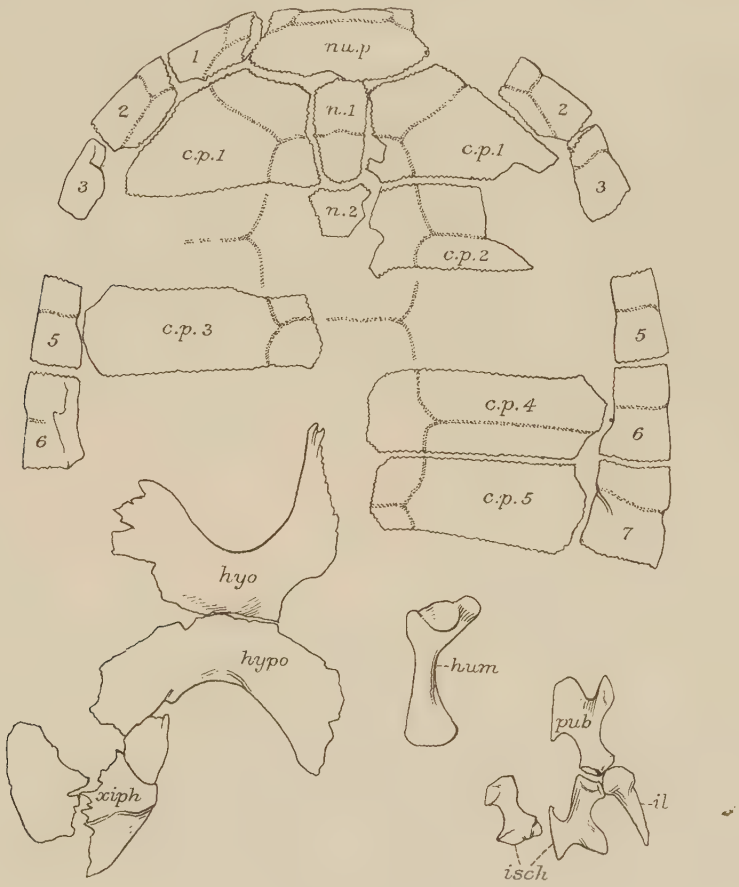


Fig. 163.—*Osteopygis borealis*. The humerus, and parts of carapace, plastron and pelvis. $\times\frac{1}{8}$.

c. p. 1, *c. p.* 2, etc., costal plates; *hum*, humerus; *hyo*, hyoplastron; *hypo*, hypoplastron; *il*, ilium; *isch*, ischium; *n.* 1, *n*, 2, first and second neurals; *nu. p*, nuchal plate; *pub*, pubis; *xiph*, xiphiplastron. 1, 2, 3, etc., right and left peripherals.

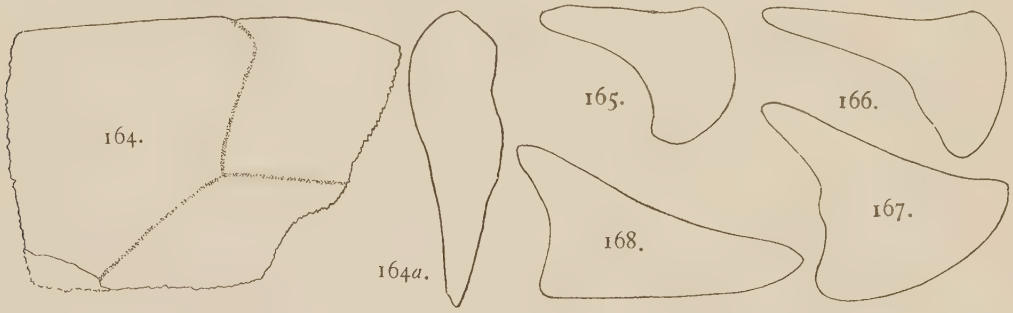
town, Monmouth County, New Jersey. It furnishes the nuchal and the first and the second neural; the second, third, fifth, sixth, and seventh right peripherals; the first, second, third, fifth, and sixth left peripherals; the first, second, fourth, and fifth right costals; the first and second left costals; the right hyoplastron and hypoplastron; both xiphiplastra; the left humerus; the left pubis and ilium; and both ilia. These bones are in a fine state of preservation.

Wieland suggested that his type might prove to belong to *O. erosus*. However, the latter differs in having thicker bones and a longer nuchal. To illustrate this statement we will consider the seventh peripheral. The length of this is 88 mm., just three-fourths that of the same bone in the type of *borealis*, yet the thickness of the inner face is 47 mm.—7 mm. more than in the latter species. This is too great to be due to age or individual variation. The length of the nuchal in *borealis* is 90 mm. This bone is not present in the type of *erosus*, but the left peripheral and first costal show that it extended backward at least 90 mm., and it certainly was still longer. If the animal had grown to be a fifth or a fourth larger the nuchal would have been much more than 90 mm. in length. The anterior peripherals of *O. erosus* are higher than those of the type of *borealis*, altho the latter belonged to a considerably larger individual.

Peripheral.	Length.	Height.	Thickness.	Width.	
				Lower face.	Upper face.
1	103	60	23	..	..
2	95	60	28	..	..
3	75	45	..	40	45
4	..	..	..	..	..
5	90	58	..	40	65
6	104	68	..	60	50
7	110	80	..	72	40

On comparing the bones of *borealis* with those of Cope's supposed *sopitus* in the American Museum of Natural History no important differences are observed. The nuchals agree. The surface of *borealis* is marked by pits resembling rain-drop impressions; but the surface of Cope's specimen is so markt to some degree, and a larger specimen referred to the species has such impressions in abundance. Some differences do appear, when careful comparisons are made among the measurements of the peripherals, but these fall within a few millimeters. Greater differences may be observed between other specimens which are regarded as belonging to *O. borealis*. Figures and measurements are presented above of various parts of Wieland's specimen. A portion of these are taken from Dr. Wieland's paper, but most of them have been kindly furnisht me by the author.

Fig. 163 is redrawn from Wieland's figure in the American Journal of Science and reduced by one-fourth making the figures one-eighth the size of nature.



FIGS. 164–168.—*Osteopygis borealis*. Peripherals of type. $\times\frac{1}{2}$.

164. First left peripheral, with section (164*a*) of the proximal end. In the section the upper surface is directed toward the left.
165. Anterior end of third peripheral.
166. Anterior end of fifth peripheral.
167. Anterior end of sixth peripheral.
168. Anterior end of seventh peripheral.

Fig. 164 presents the first left peripheral from above, together with a view of the end which joins the nuchal bone; figs. 165, 166, 167, and 168 represent the anterior ends respectively of the third, fifth, sixth, and seventh right peripherals.

The length of the first neural is 102 mm.; its greatest width is 55 mm. The first costal has a maximum width of about 120 mm. The second is 90 mm. wide at the costo-vertebral sulcus. The first vertebral scute is about 285 mm. wide; the second, about 180 mm.

The plastron (fig. 163) in general resembles that of *O. gibbi;* but the fontanels appear to have been larger and the bridge was wider. The latter has a width of 138 mm. The whole plastron had a width, taken across the hypoplastra, of about 520 mm. The hyoplastron extended forward from the hyohypoplastral suture 138 mm.

The humerus (fig. 163, *hum*) has an extreme length of 170 mm. The shaft dorso-ventrally is 17 mm. thick. The smooth rounded end is 54 mm. wide. The ulnar crest rises above the head. Between the plane of the two proximal processes the angle is obtuse.

The pelvis (fig. 163 11, *isch*, *pub*) resembles in general that of *Chelydra*.

The specimen referred to above as having been described by Cope as *Osteopygis sopitus* is now in the American Museum of Natural History and has the number 2351. It consists of peripherals one to four, seven, eight, and ten, of the right side; peripherals one, three to five, seven, eight, and ten, of the left; the nuchal, the proximal portions of costals one to four of the left side; one nearly complete costal, perhaps the third of the right side; many fragments of other costals; a number of plastral bones; parts of both humeri; and a complete left femur.

Cope has, from this specimen, produced a figured restoration of the carapace (Ext. Batr. Rept., etc., p. 139, fig. 39). This is represented as having 10 pairs of costal plates and a corresponding number of neural bones. It is difficult to understand how that author could suppose that the rib of the first costal could extend far enough forward to enter the pit in the second peripheral. Evidently he saw no other possible use for the pit. The eleventh peripheral is not present. On the tenth is found the number "10," written in ink; but at that time the right hand digit "0" was written upon a "1." Altho on page 235 of the work cited, Cope concluded that the genus *Osteopygis* had only nine pairs of costals, he maintained, from examination of the present specimen, that *Propleura* had ten pairs. Nevertheless, in his Vertebrata of the Tertiary, publisht in 1884, he stated that *Osteopygis* had 10 pairs and *Propleura* 9 pairs.

Peripheral.	Length.	Height.	Thickness.	Width.	
				Lower face.	Inner face.
1	77	43	13	..	..
2	..	40	18	..	..
3	70	32±	..	29	30±
4	73	36	..	29	40
5	75	47	..	34	43
6	..	50±	..	48	30±
7	92	65±	..	57	24
8	90	..	16	..	..
9	..	..	10	..	..
10	87	88	10	..	..

Cope figured a part of the nuchal, the first left peripheral, and a part of the first left costal. They are refigured (fig. 169, p. 145), with the addition of fragments overlookt by Cope. The front of the carapace, along the nuchal, was somewhat concave. The free borders of the nuchal and the anterior peripherals are obtuse and thick. At the midline the nuchal is 10 mm. thick. The fore-and-aft length of the nuchal is 78 mm.; its width along the free border was close to 120 mm. The border which joined the first neural is only 5 mm. thick. The table gives the dimensions of the peripherals, the measurements, except the lengths, being taken at the anterior ends. In a few cases a dimension has been taken from the contiguous end of the peripheral in front.

The first peripheral was suturally joined to the first costal; probably also the second, but the border is missing. It is probable that all the other peripherals to the eleventh were free from the contiguous costals, but the upper border of the fifth has some appearance of having formed a suture. The upper faces of the anterior peripherals are nearly plane. Beginning with the fifth, the upper faces are more or less concave from the free edge to the costal border. The hinder peripherals have a thin acute border and this may be traced forward, but becoming less acute, to the first peripheral. In the hinder end of the second peripheral, in the inner face, is a pit, like a deep thumb impression, for the anterior prolongation of the hyoplastron. The other peripherals have each a pit for the end of the corresponding rib. They are at the middle of the length of the inner face. Most of them are circular in section, but those of the last two or three peripherals are somewhat flattened; and they notch the upper face of the bone.

The first costal has a maximum width of 98 mm. The second is 66 mm. wide; the third, 60 mm.; the fourth, 46 mm., all measured at the costo-vertebral sulcus. At the sutural borders these bones are 5 mm. thick.

The surface of most of the bones is more or less roughened; and on many of them, especially the costals, there are present scattered pits, each about 3 mm. in diameter. These pits are less conspicuous on the hinder peripherals.

The area of the scutes of the carapace is distinctly markt. The nuchal scute measures 58 mm. along the free border; 90 mm. along the posterior border. Fore and aft it is only 20 mm. The first vertebral had a width of about 200 mm. Its length was 100 mm. The second vertebral was 100 mm. wide and 150 mm. long. Behind the first peripheral the costo-marginal sulcus ran along the unossified space between the costals and the peripherals.

The plastron evidently had the form presented in *O. gibbi*. The piece of the bone considered by Cope as the epiplastron is the anterior outer end of the hyoplastron. At the axillary notch the hyoplastron had a thickness of 11 mm. At the inguinal notch the hypoplastron was 14 mm. thick. As in the other species, there was an interchange of digitations between the hypoplastron and the xiphiplastron.

Cope figured the right humerus. This bone lacks the head, both trochanters, and a little of the distal end. The original length must have been close to 120 mm. The radial and the ulnar crests made apparently something more than a right angle with each other. The shaft is bent and flattened. The dorso-ventral diameter is 13 mm.; the horizontal diameter, 19 mm. The width of the distal end is 38 mm. The femur is practically complete. The extreme length is 132 mm. The bone resembles closely that of *Chelydra*. The planes of the tibial and the fibular crests make a right angle with each other. The diameter of the shaft is 14 mm.; that of the distal end, 36 mm.

In the American Museum of Natural History are portions of a large individual which is referred to this species. There are present peripherals 7 to 11 inclusive of the left side, peripherals eight, ten, and eleven of the right side, and a considerable part of the hindermost suprapygal. With these are other bones, some or all of which may belong to another individual, possibly to another species. These consist of 2 complete costals, 3 neurals, the left hyoplastron lacking the inner end, the left hypoplastron lacking a small portion of the outer end, and a femur. Besides these, there are parts of first, second, and third suprapygals that can not belong to the same individual as did the peripherals. All these bones are included under the number 1132. This is the specimen mentioned by Cope (Ext. Batr., Rept., etc., p. 142) as having been found at Hornerstown, Monmouth County, New Jersey.

Peripheral.	Length.	Height.	Thickness.	Width.	
				Lower face.	Inner face.
7	113	78	..	67	44
8	114	93	..	90	24
9	106	103	17	..	..
10	105	117	16	..	..
11	95±	110	16	..	..

The peripherals (plate 26, fig. 3) indicate a large individual, with a carapace about 825 mm. long. The dimensions of the peripherals are given in the table above, the measurements being taken as in the case of the type specimen.

The pits for the rib-ends entering the hinder three peripherals are flattened, as in the No. 2351, and similarly they notch the upper face of the bones. None of the peripherals present was suturally articulated with the costals, but the eleventh was sutured with the hindermost suprapygal. The latter had a length of about 75 mm. and a width of 180 mm. It was therefore quite different from that of *O. gibbi*.

A fragment that must have belonged to another individual presents the first, second, and a part of the third suprapygals, and a part of the eighth costal. The first suprapygal is about 40 mm. long and the width is the same. The second suprapygal has a length of 45 mm. and a width, along the nearly straight hinder border, of about 130 mm. Of the third there is only a small piece. The first suprapygal is crost by the sulcus between the fourth and the fifth vertebral scutes.

One of the costals is probably the third of the right side. It has a length, over the curve, of about 275 mm., not including the projecting rib-end. The breadth near the proximal end is 87 mm.; near the distal end, about 95 mm. The thickness at the sutural edges is 7 mm. The distal end had not been sutured with the peripherals. Articulated with this costal is a neural, probably the third. Its length originally was about 90 mm.; its breadth anteriorly is 58 mm. The posterior end is narrowed and rounded. The costal and this neural supported portions of the third and fourth vertebral scutes. The fourth, at the hinder border of the costal, had a width of about 140 mm.; the third was apparently slightly narrower.

All the bones of the carapace here described are plentifully furnisht with pits. These vary in size from 1 to 10 mm. in diameter. That some of them are not the result of disease or parasites can hardly be affirmed, but they must have been produced during the life of the individual.

The plastron may not have belonged to the individual that furnisht the peripherals; but the size befits it. In form it agrees with that of *O. gibbi*. At the narrowest portion of the bridge the hyoplastron and hypoplastron are each 67 mm. wide. As nearly as can be determined, the width of the plastron from side to side was about 480 mm. There was evidently a fontanel inclosed by the two plastral bones mentioned and the peripherals. There was another at the crossing of the median and the hyohypoplastral sutures. There was probably still another at the midline just in front of the xiphiplastrals.

The thickness of the bones at the bridge is 20 mm.

The femur lacks the distal end. In form it resembles that of supposed *O. sopitus*, as figured by Cope; but the size is greater. The diameter of the shaft is 18 mm.

No. 2216 of the American Museum of Natural History comes from some unknown locality of the Cretaceous greensand of New Jersey, and forms a part of the Cope collection. It

FIGS. 169–171.—*Osteopygis borealis*. Portion of carapace and lower jaw.

169. Front of carapace of specimen regarded by Cope as *O. sopitus*. No. 2351 A.M.N.H. *c. p.* 1, first costal plate; *nu. p*, nuchal plate; *nu. s*, nuchal scute; *per.* 1, first left peripheral. $\times\frac{2}{5}$
170. Lower jaw, seen from above. No. 2216 A.M.N.H. $\times\frac{1}{2}$
171. Section along symphysis of same jaw. $\times\frac{1}{2}$

is referred confidently to the present species, altho some differences may be observed. It furnishes peripherals three, four, six to ten of the left side, five and eight of the right side; the eleventh of one side or the other; the outer end of the left hypoplastron; and a large part of the lower jaw. The latter is here described and figured.

Fig. 170 represents the jaw as seen from above. Fig. 171 is a section along the symphysis. The length of the symphysis is 62 mm. The thickness at the hinder end of the symphysis is 18 mm. This is gradually reduced forward. The symphysis extends backward about 9 mm. behind the line joining the mental foramina. The width at the mental foramina is 92 mm. The crushing surface is broad and flat, rising at the sides to the cutting-edges. For a distance of about 32 mm. from the tip the cutting-edges are acute and are directed outward; they then become obtuse, as is shown by section. There certainly was no upturned beak at the tip of the jaw. Along the inside of the rami and behind the symphysis is a deep groove. The lateral halves of the jaw are solidly co-ossified, but there remain distinct traces of the suture.

Osteopygis borealis differs from *O. emarginatus*, *O. gibbi*, and *O. robustus* in not having the peripherals between the second and the eleventh joined by suture with the distal ends of the costals. From *O. erosus* it differs in having bones of much thinner and lighter construction. The anterior peripherals are, relatively to their length, of less height. In *O. borealis* the pits for

the ribs notch both the upper and the lower faces of the peripherals behind the seventh; in *O. erosus* they notch only the upper borders.

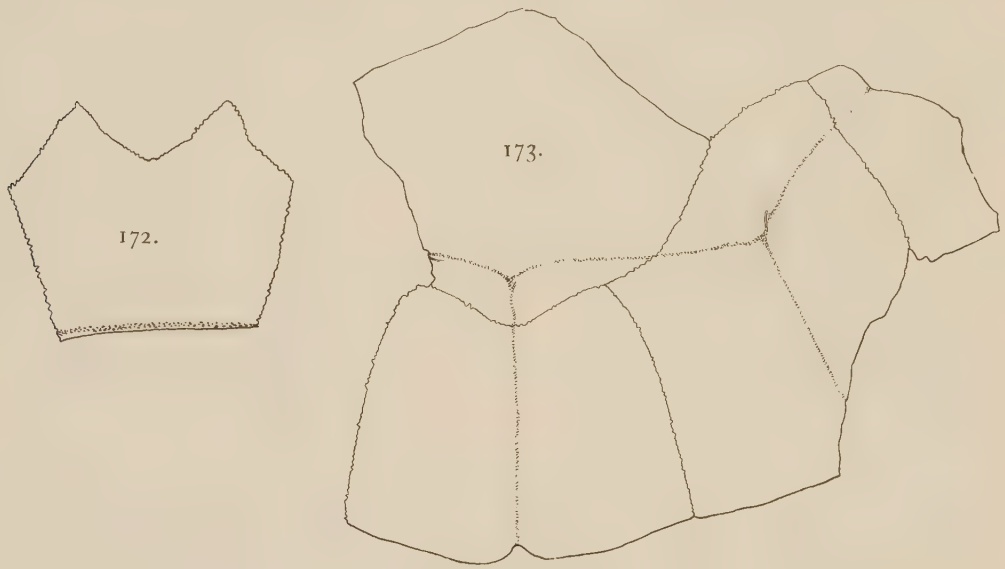
O. platylomus differs in having the anterior peripherals higher in proportion to their length and in having the upper border of the first and second thicker. In *O. platylomus* the rib-pits of the sixth and seventh peripherals are decidedly flattened; in *O. borealis* they are conical. *O. chelydrinus* differs in having the free border of the hinder peripherals angulated.

Osteopygis platylomus Cope.

Figs. 172–180.

Osteopygis platylomus, Cope, Amer. Naturalist, III, 1869, p. 89; Cook's Geol. New Jersey, 1868 (1869), p. 735; Ext. Batrach., Reptilia, Aves N. A., 1869, pp. 135, 137, and p. ii, figs. 38, 39; Vert. Cret. Form. West, 1875, p. 258.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441.

The type of Cope's *Osteopygis platylomus* is a fragmentary specimen which belongs to the Academy of Natural Science of Philadelphia. It was presented to that institution by Samuel Ashhurst, having been discovered in the uppermost greensand bed of the Cretaceous, at Pemberton, Burlington County, New Jersey. It now consists of the anterior half of one neural,



Figs. 172 and 173.—*Osteopygis platylomus*. Portions of type.

172. Part of a neural. ×⅔. 173. Pygal, suprapygal, and tenth and eleventh peripherals. ×½.

most of the suprapygal, a portion of the nuchal, wholes or parts of all the peripherals of the right side, except the fifth, wholes or parts of the first, third, sixth, eighth, ninth, tenth of the left side, many fragments of costals and portions of the plastron. It appears that a few parts have been lost since Cope described the specimen.

Cope estimated the length of the carapace at 2 feet 2 inches. The writer regards the length as having been close to 30 inches or about 750 mm.

The fragment of neural (fig. 172) is crost by a sulcus and is therefore probably either the third or the fifth. It is deeply notcht in front for the preceding neural, and this notch gives evidence that the neural was not the first one. The greatest width of the bone is 56 mm.

The bone described by Cope as the "posterior vertebral" is really the suprapygal. Only a portion of the left end of the nuchal remains. It is articulated to a portion of the first left peripheral. The free edge is obtuse and at the suture with the first peripheral the thickness is 17 mm. The bone extends backward from the free border a little more than 60 mm., to articulate with the first costal. Here the thickness is only about 6 mm. The first marginal scute occupies the outer end of the nuchal and the anterior end of the first peripheral. Along the free border it is 58 mm. and it extends backward from the free border of the bone 33 mm. Cope states that the nuchal scute was confluent with the first vertebral; but the writer regards

this as a mistake. After passing about 6 mm. the sulcus between the nuchal scute and the first marginal, the sulcus between the nuchal and the vertebral scutes suddenly becomes very shallow, but the writer believes that it continues on in its usual position.

A considerable part of the suprapygal (fig. 173) is missing. Cope's statement that it is only 2 inches and 4 lines wide is an error or meant to apply to some other bone. The bone in question is at least 110 mm. wide. It occupies an area that in *O. gibbi* is occupied by two bones, but a close examination shows a line running from the upper angle of one eleventh peripheral to that of the opposite side, along which 2 bones have co-ossified. The angulation of the upper border of the eleventh peripheral shows that there were two suprapygals. It is probable that the sutural edge of the eleventh peripheral joined the anterior suprapygal instead of the eighth costal plate. The dimensions of the peripherals are shown in the table.

Peripheral.	Length free border.	Height at sulcus.	Width.	
			Lower face.	Inner face.
1	71	52	9	53
2	75	49	15	47
3	70	..	27	37±
4	73	..	29	37±
5	..	..	..	..
6	86	51	41	37
7	88	58	50	29
8	90	68	65	20
9	88	52	64	..
10	..	..	..	..
11	80	95	..	..

The sixth peripheral (figs. 174, 175) presents three faces, an upper concave, a lower convex, and an inner irregular. The upper and lower faces meet at the acute free border. In the inner face is a large, somewhat flattened pit for the end of a rib. Its mouth occupies one-half the length of the face. Along the lower border of the face are two or three shallow pits for digitations of the hypoplastron.

As we proceed forward from the sixth peripheral the free border becomes less acute, until, on the third, it is obtuse and the upper, now convex, face rounds into the lower. On the second and first peripherals (figs. 176, 177) the lower face becomes the obtuse free border of the bones. The inner faces of the fourth and the third contain pits for the corresponding rib-ends. The inner face of the second has a large excavation which received the anterior outer process of the hyoplastron. Fig. 176 represents the first, second, and third peripherals of the right side.

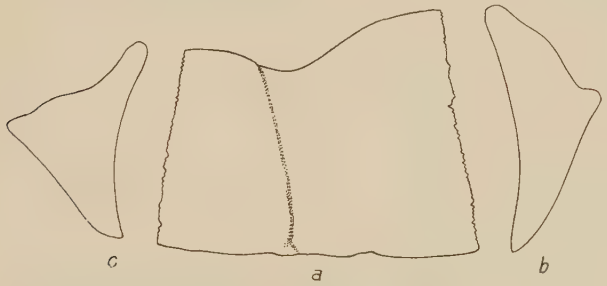


FIG. 174.—*Osteopygis platylomus*. Sixth left peripheral of type. ×½.

a, from above; *b*, hinder end; *c*, anterior end.

The upper border of the first and the anterior half of that of the second peripheral had a sutural articulation with the first costal (fig. 176). The thickness of these borders is 6 mm. The hinder half of the upper border of the second and the upper borders of all the other peripherals to the eleventh are smooth. The upper border of the eleventh appears to have articulated with the suprapygals, as already stated.

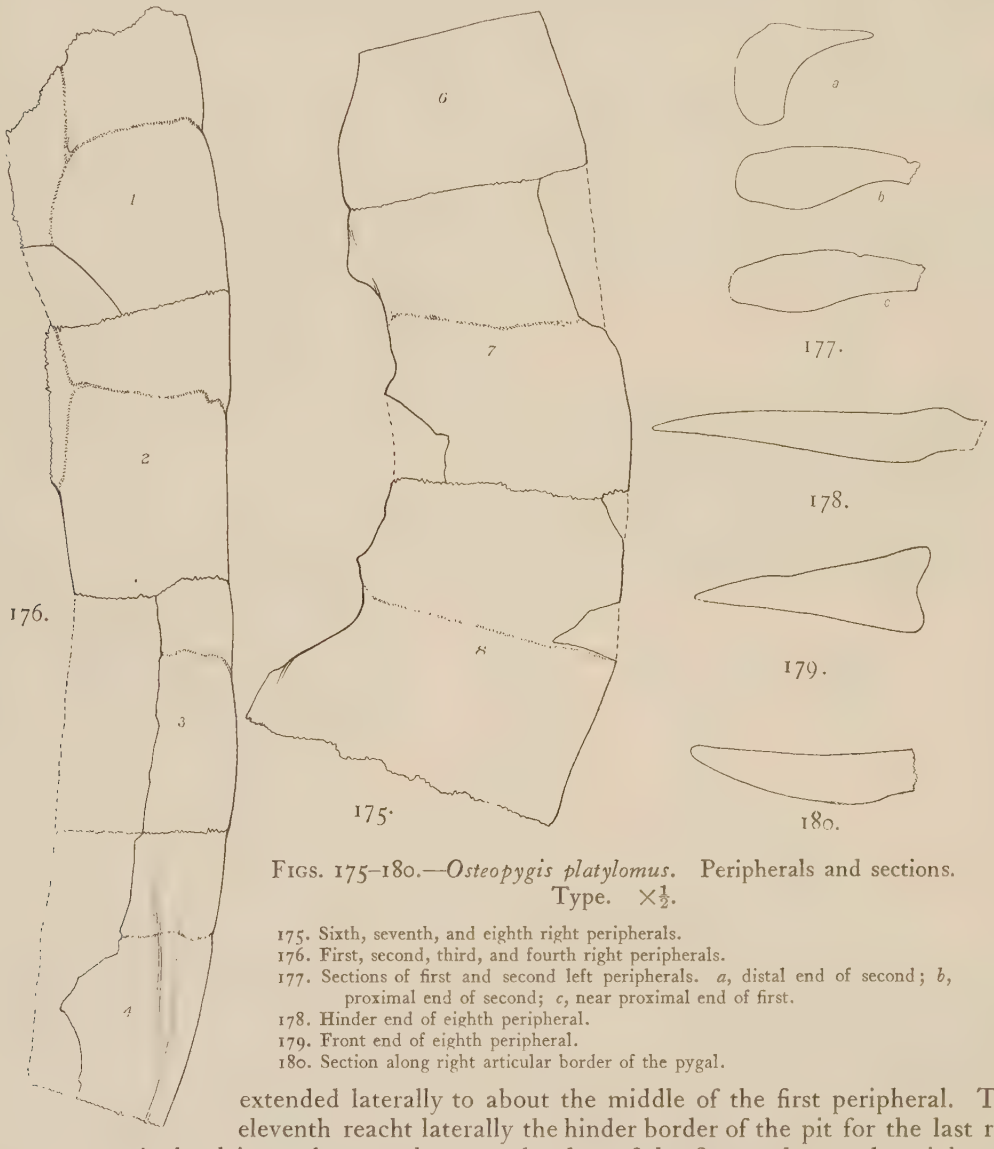
Passing backward from the sixth peripheral, the upper and lower borders of all the peripherals broaden and become flatter. The inner face narrows, and finally on the eighth (figs. 178, 179) and succeeding peripherals, curves into the lower face. Each of these peripherals, except the eleventh, has a pit for a rib-end. The hindermost peripherals are thin, the ninth being 14 mm. thick, the eleventh about 10 mm. The flattening of the rib-pits begins with the sixth peripheral. The pygal is represented by fig. 173. Fig. 180 shows one lateral border.

There are present many fragments of costal bones, but no complete costal. The remains seem to show that the carapace was rather flat. The thickness of the costals near the neurals was about 6 mm.; near the distal ends, about 5 mm. The rib-heads were strongly developt. Distally, each rib projected beyond the costal and entered the pit in a corresponding peripheral. The edges of the costal plates approacht closely the upper borders of the peripherals.

On the proximal ends of two costals the costo-vertebral sulci run along about 35 mm. from the neural border. Another fragment shows that the vertebral scute was strongly angulated

laterally. The distal end of a costal bone is 70 mm. wide. The surface of the bones is usually moderately smooth, but markt by irregular, rather straight, vascular grooves. The sulci are usually quite distinct.

The nuchal scute is present, as stated. Its lateral extent is conjectural; the fore-and-aft width is about 30 mm. The widths of the vertebral scutes can not be exactly determined; but they all appear to correspond closely to those of *O. gibbi* Wieland. The first evidently



FIGS. 175–180.—*Osteopygis platylomus*. Peripherals and sections. Type. $\times\frac{1}{2}$.

175. Sixth, seventh, and eighth right peripherals.
176. First, second, third, and fourth right peripherals.
177. Sections of first and second left peripherals. *a*, distal end of second; *b*, proximal end of second; *c*, near proximal end of first.
178. Hinder end of eighth peripheral.
179. Front end of eighth peripheral.
180. Section along right articular border of the pygal.

extended laterally to about the middle of the first peripheral. The eleventh reacht laterally the hinder border of the pit for the last rib. The costo-marginal sulci run along on the upper borders of the first and second peripherals, then disappear, to reappear on the upper borders of the eighth to the eleventh. From the third to the eighth peripherals the sulci occupied doubtless the space between the costals and the peripherals.

At present there remain of the plastron only a part of the left hyoplastron, most of the left hypoplastron, and most of the right xiphiplastron. The plastron seems not to have differed in any important way from that of *O. borealis*. Evidently there was a fontanel between the hyoplastra in front and the hypoplastra behind. At the narrowest part of the bridge the hypoplastron is 58 mm. wide. The thickness at the inguinal notch is 16 mm. No sulci are to be seen on these bones, except a faint one near the base of the xiphiplastron. To the present writer it seems evident that the bones on the right of Cope's figure of the plastron of this species

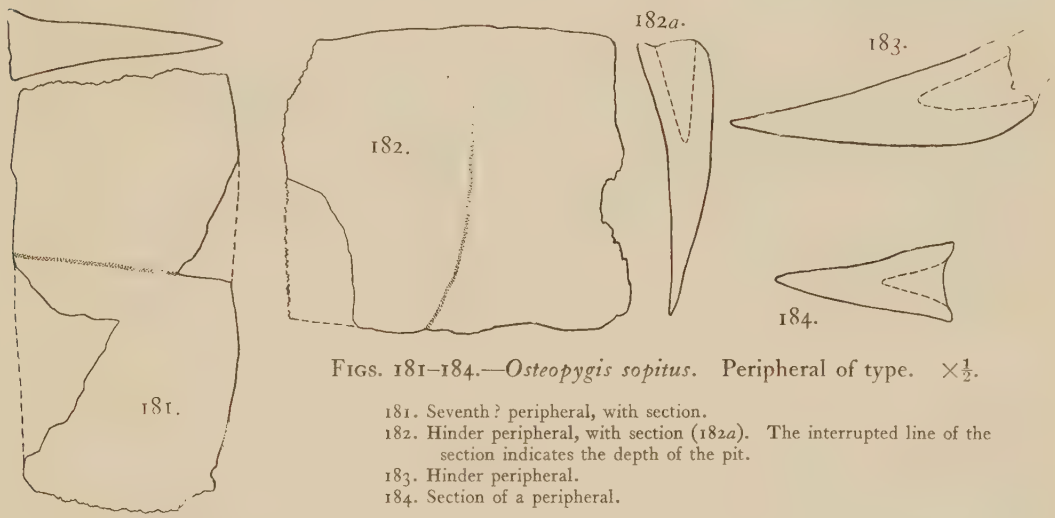
have been taken from the plastron of one of the specimens described by him as *O. emarginatus*. Remarks on this specimen are made under the last-named species. In Cope's figure of the plastron the hyoplastron on the left side of the drawing is placed too horizontally. The anterior outer angle ought to be directed strongly forward. This species resembles *O. borealis*. For differences see under the latter species.

Osteopygis sopitus Leidy.

Figs. 181–184.

Chelone sopita, Leidy, Smithson. Contrib. Knowl., xiv, 1865, pp. 104, 119.—Maack, Palæontographica, xviii, 1869, pp. 238, 283.
Osteopygis sopitus, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441 (in part).

The type specimen of the present species has not hitherto been figured. It belongs to the New Jersey State collection and is at Rutgers College, New Brunswick, New Jersey, where the writer has examined it. This type consisted of 4 peripherals, but Leidy was uncertain whether or not they belonged to one individual. These bones had been obtained in the Cretaceous greensand at Tinton Falls, Monmouth County, New Jersey, probably in the upper bed. Other specimens, which were mentioned by Leidy in his description of this species and figured, were afterwards referred by Cope to *Lytoloma angusta*, and probably correctly so.



Figs. 181–184.—*Osteopygis sopitus*. Peripheral of type. $\times\frac{1}{2}$.

181. Seventh ? peripheral, with section.
182. Hinder peripheral, with section (182*a*). The interrupted line of the section indicates the depth of the pit.
183. Hinder peripheral.
184. Section of a peripheral.

Other specimens were referred by Cope to Leidy's species. One of these had been secured at Harrisonville, Salem County, New Jersey, in a sort of limestone. This specimen is now in the American Museum of Natural History and has the number 2361. Almost certainly it is not a species of *Osteopygis*, and it has in the present work been referred provisionally to *Rhetechelys platyops* (Cope).

The four peripherals of the type belonged behind the bridges. Figures taken from three of these are here presented. Fig. 181 represents in outline one which is regarded as being the right seventh. It is 115 mm. long, 59 mm. wide near the anterior end, 20 mm. thick at this end, and 12 mm. at the posterior end. There are 3 faces—an upper, a lower, and an inner, or visceral. The pit for the rib is nearer what is regarded as the hinder end and is somewhat flattened in section. Above the figure is a section taken at the anterior end of the bone. Another peripheral (fig. 182) is about 87 mm. long, 82 mm. wide, 18 mm. thick at one end, 14 mm. at the other. In the visceral face is a pit for the end of a rib. Each diameter of the pit at its opening is 9 mm. The upper face is quite concave from the acute free border to the costal border. Near the figure is a section (182*a*) taken at the thicker end of this peripheral, which represents the diameter and depth of the rib-pit. Another peripheral, probably a ninth or tenth, has the costal border broken away. The rib-pit is flattened. Figure 183 is a section of this bone. Its greatest thickness is 24 mm. Fig. 184 is a section taken along the transverse sulcus of a fragment representing about one-half of a peripheral. The upper and lower faces

measure 48 mm. each, while the concave visceral face is 22 mm. wide. The mouth of the pit is circular.

Cope referred to this species a specimen which now has the number 2351 of the American Museum and which is regarded here as belonging to the species since described by Wieland as *Propleura borealis*, here as *Osteopygis borealis*. If all of the peripherals described by Leidy belong to the same species this can not be the same as Cope's species; for the peripheral here represented by fig. 181 is too long and narrow. Furthermore, the peripheral with the missing costal border is too thick. In the doubt, therefore, it seems best to regard Leidy's materials and Cope's as belonging to distinct species, making the elongated peripheral of Leidy's specimens the type of his species and leaving it to future discoveries to determine whether or not any of Leidy's materials are co-specific with Cope's specimen.

Genus CATAPLEURA Cope.

A genus not well known. Nuchal bone little broader than the anterior peripherals. Nuchal and first and second peripherals suturally joined to the first costal bone. The other peripherals to the eleventh probably not suturally connected with the disk of the carapace. No pit in the second peripheral for the hyoplastron. A pit in the eleventh peripheral for the rib of eight costal. Plastron probably resembling that of *Osteopygis*, but not extending so far along the peripherals.

Type: *Catapleura repanda* Cope.

This genus differs from *Lytoloma* in having the two anterior peripherals solidly joined to the first costal. It differs from *Osteopygis* in the much narrower nuchal bone and in having no pit in the second peripheral for the process of the hyoplastron. From both *Lytoloma* and *Osteopygis* it differs in the much thicker posterior peripherals.

The genus was establisht by Cope in 1870 (Ext. Batrach., Reptilia, Aves N. A., p. 143). On page 235 of the work cited Cope exprest himself in doubt whether there were nine or ten costal plates present. In 1884 (Vert. Tert. Form. West., p. 112) doubt is exprest whether there were 9 costals. There can now be no doubt that this genus, like *Osteopygis* and the great majority of turtles, had only 8 pairs of costals.

Catapleura repanda Cope.

Figs. 185–188.

Osteopygis repandus, Cope, Proc. Acad. Nat. Sci. Phila. 1868, p. 147 (nom. nud.).—Hay, Bibliog. and Cat. Foss., Vert. N. A., 1902, p. 441.

Propleura repanda, Cope, Cook's Geol. New Jersey, 1868 (1869), p. 735 (nom. nud.).

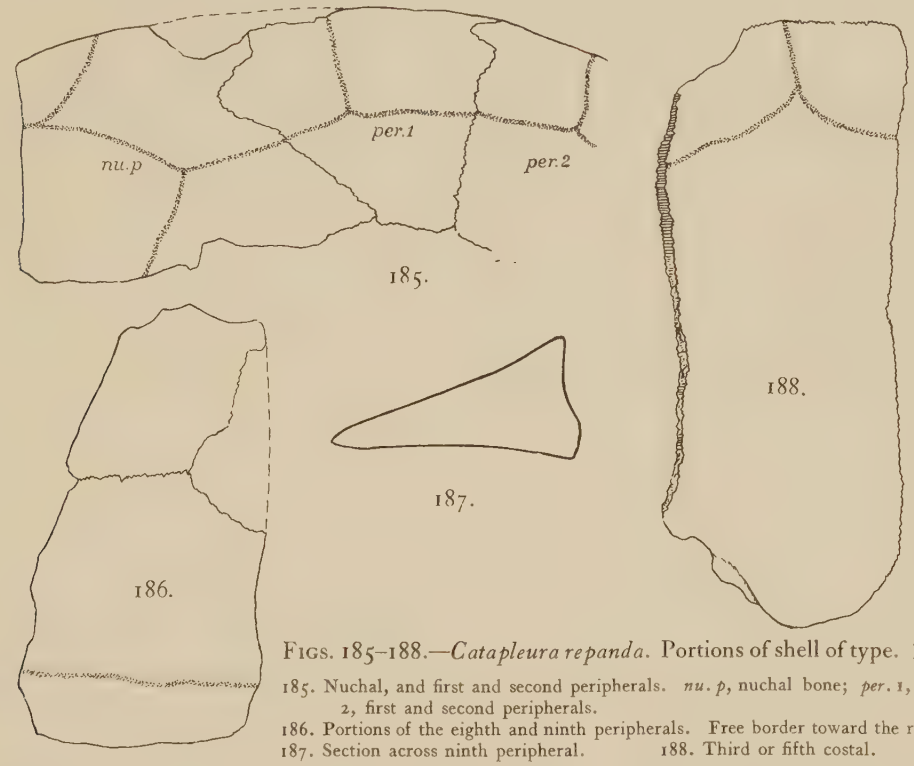
Catapleura repanda, Cope, Ext. Batrach., Reptilia, Aves N. A., 1869, p. 143, plate vii, fig. 2; Vert. Cret. Form. West, 1875, p. 259.

The present species is based on very meager materials and none additional has been discovered since the first description of the species. The type is now in the American Museum of Natural History and consists of a part of the nuchal, the succeeding three peripherals and a part of the fourth of the right side, the first of the left side, and four other peripherals, one nearly complete costal and parts of others, and a portion of a femur. The catalog number is 2353. These bones were obtained from the upper bed of Cretaceous greensand at Barnesboro, Gloucester County, New Jersey.

The nuchal bone (fig. 185) is remarkable for its narrowness fore and aft, being only 47 mm. The widths of the first and second peripherals are respectively 43 mm. and 44 mm. The free border of the nuchal is somewhat obtuse and the thickness soon becomes 10 mm., at the end of the bone. The posterior border articulated suturally with the first costal. The posterior sutural edge is oblique to the surfaces of the bone and the nuchal slightly overlapt the first costal. The thickness of this border is 8.5 mm. The posterior border of the nuchal was much wider from side to side than the anterior border. On the end of the nuchal, nearer the anterior border, there is a notch which receives a process of the first peripheral (fig. 185). The latter measures 50 mm. along the anterior border, 17 mm. along the posterior. Its free border is more obtuse than that of the nuchal. The second peripheral (fig. 185) extends 53 mm. along the free border. It is 13 mm. thick near the free border, 7 mm. thick at the hinder

border. The hinder border both of this bone and of the first peripheral is oblique and overlapt the first costal, as did the nuchal. The hinder half of the upper border of the second peripheral is broken away and we can not tell how much of it was sutured to the costal. There is no pit in the second for the anterior outer angle of the hyoplastron, and it is not probable that the latter bone extended so far forward.

The third peripheral is 60 mm. long on the thickened and obtuse free border. On the inner face is a deep pit, directed backward, for the rib-end of the first costal. Below this, in the projecting edge is a notch, possibly for a digitation of the hyoplastron. Of the fourth peripheral there is present only a portion. Its lower face is 26 mm. wide, and this makes an angle of ninety degrees with the upper face, the angle where they meet being rounded off. The upper borders of the third and the fourth peripherals are broken away. Cope figured what he regarded as the sixth peripheral, and there is a fragment of a peripheral, which he has markt as the sixth; but it is impossible now to to say that the bone present is the one figured. The bone has one face, apparently the upper, 44 mm. wide. Another face, somewhat concave, is separated from



FIGS. 185–188.—*Catapleura repanda*. Portions of shell of type. $\times\frac{2}{3}$.

185. Nuchal, and first and second peripherals. *nu. p*, nuchal bone; *per.* 1, *per.* 2, first and second peripherals.
186. Portions of the eighth and ninth peripherals. Free border toward the right.
187. Section across ninth peripheral. 188. Third or fifth costal.

this by a subacute free border. Cope has figured what he regarded as the eighth and part of the ninth peripherals. In reality, there is only a small portion of the eighth and about two-thirds of the ninth (fig. 186). Evidently these belong to the right side, since the intermarginal sulcus crosses in front of the rib-pit. The latter is in the hinder half of each bone. The upper border of the upper face of both these bones is missing, but that part of the face of the ninth which remains is 47 mm. wide and is slightly concave. The lower face, also slightly concave, is 46 mm. wide. The inner face has been about 25 mm. wide. Fig. 187 is a section of the ninth along the intermarginal sulcus. The outer free border of the bone is acute and has projected slightly at the end of the intermarginal sulcus, making the free border somewhat repand.

On the free border and between the two bones here described is a long notch which, during the life of the animal, inclosed a distinct ossicle. This reminds us of similarly disposed ossicles described by Wieland as occurring in his *Lytoloma angusta* (*L. wielandi*), and which he was inclined to regard as a part of a disappearing primitive osteo-dermal armor of turtles. From the manner of growth of the horny scutes one would rather expect to find such bones, if a part of the ancient armor, at the ends of the intermarginal sulci.

There is present a part of a peripheral which Cope has labeled as the tenth. The upper borders of both the upper and lower faces are missing, but these faces are yet 58 mm. wide. At its upper, or proximal, border, the bone is 18 mm. thick. The hinder half of the bone is lost but enough apparently remains to show a part of the rib-pit, had it been present in the bone. Since in *C. ponderosa* the eighth costal sent its rib-end into the eleventh peripheral, it is probable that there was no pit in the tenth. If the bones regarded by Cope as the eighth, ninth and tenth are really such they differ greatly from the corresponding bones of *Osteopygis*, being, relatively to their length and height, much thicker.

The costals are extremely interesting, but they are not well understood. There is one which is nearly complete, quite certainly either the third or the fifth. It has a width of about 50 mm. (fig. 188). The curvature shows that the carapace was considerably archt from side to side. Cope regarded this costal as that of the right side, but there are reasons for believing that it belongs to the left. One sutural border is thicker and has the suture oblique to the surface of the bone in such a way that it must have been overlapt by the contiguous bone. We have seen that the hinder border of the nuchal and the first two peripherals overlapt the first costal. It seems improbable that from having the anterior border overlapt in the first costal a change would be made, about the middle of the shell, to having the posterior border overlapt. The present costal can not, however, be the first, for the proximal end of its fellow bone is present and does not accurately fit to the nuchal and first peripheral. It can not be the second, for it is not traverst by a sulcus separating two costal scutes. It seems probable that it is the left third. The posterior sutural edge is at right angles with the surface and hence it did not overlap the succeeding bone. The thickness, too, is reduced to 5 mm. The upper surface of the costals is smooth. On the one described there are parts of 2 vertebral scutes, probably the second and the third. On the supposed posterior border of the bone the costo-vertebral sulcus is 25 mm. from the neural border. The surfaces of the peripherals are markt by zigzag vascular grooves.

On the under side of the costal is seen a large rib-head and stout ridge proceeding from it to the distal end. At the proximal end this ridge lies a little nearer to the supposed anterior border and on its way to the distal end it gets closer to this border, being only 3 mm. away from it finally. In his description Cope states this ridge lies near the posterior border. In front, that is on the side next the beveled border of the costal, there is a rough groove, as if a rudimentary first rib had been applied against the ridge. The meaning of the groove is unknown. It is found in three of the costals represented.

Not enough of the femur is present to furnish definite information regarding its structure. The head is missing. The shaft has a diameter of 11 mm.

What is determinable regarding the vertebral scutes has been stated above. On the nuchal and the anterior peripherals the marginal scutes rise only a moderate distance above the free border of the shell. On the median and hinder peripherals the costo-marginal sulci appear to have followed the unossified space between the costal and peripheral bones. The nuchal bone does not reach the midline, and hence we can not determine exactly what was its width nor that of the nuchal and first vertebral scutes. The boundary between the nuchal scute and the first marginal is believed to be where shown in fig. 185. The first vertebral scute lacks a considerable space of reaching the outer ends of the nuchal bone, and was, hence, evidently narrow. The first marginal rises about 28 mm. above the border of the carapace; the second about 18 mm.

Catapleura ponderosa Cope.

Figs. 189, 190.

Catapleura ponderosa, COPE, Proc. Amer. Philos. Soc., XII, 1871, p. 46; Vert. Cret. Form. West, 1875, p. 259.
Osteopygis ponderosa, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441.

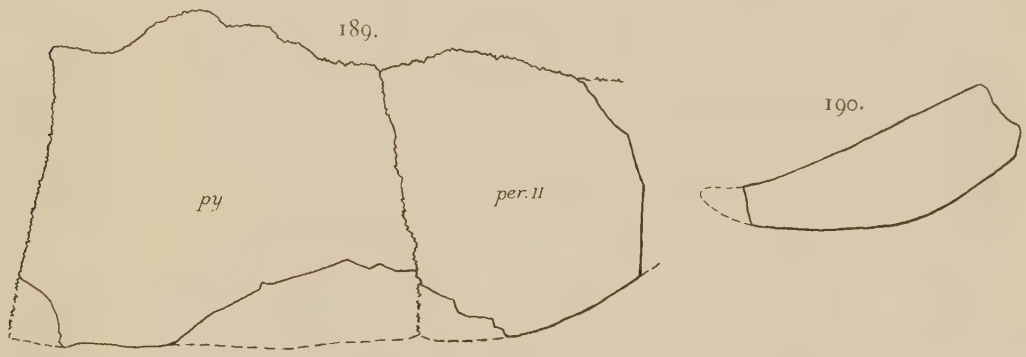
The present species is based on materials even less satisfactory than is *C. repanda*. They consist of portions of the eleventh peripheral and the pygal, portions of about 6 costals, a part of a supposed hypoplastron, a scapular arch, a considerable part of a humerus, a part of a femur and a part of a lower jaw.

The type is now in the American Museum of Natural History and has the number 1475. These bones were obtained by Cope from the uppermost bed of Cretaceous greensand, at Hornerstown, New Jersey.

The pygal bone (figs. 189, 190) had a width of about 80 mm. along the free border. Some of the upper border has crumbled away, but the height of the bone was close to 65 mm. Its thickness a short distance below the upper border is 19 mm. The upper surface is concave fore and aft; convex from side to side. On the lower side the directions of these forms of surface are reverst. The free border is acute. The upper border was probably suturally articulated with the suprapygal. On neither the upper nor the lower side of this bone is there any trace of a sulcus.

Of the eleventh peripheral Cope had no more than is now present, the hinder half, articulated with the pygal. It is concave from the free edge to the upper border on the upper surface, rather strongly convex on the lower surface. In the upper border there remains a portion of the deep pit for the rib-head of the eighth costal. The greatest thickness of the bone is 19 mm. While a considerable part of the free border is broken away, that remaining seems to indicate that this border was emarginate, as was stated by Cope. No sulcus appears on this bone.

Two of the costals represented are evidently those of the same pair. Cope thought they were those of the second pair. The proximal end was 82 mm. wide. One of the sutural borders is 11 mm. thick, and the suture is oblique to the surfaces of the bone. It was evidently overlapt by the bone to which it was articulated. The opposite border is only 5 mm. thick. Under *C. repanda* reasons have been given for regarding the border bearing the oblique suture as the anterior one; and the costals of the two species are so similar that the same rule applies here. As in *C. repanda*, the rib-head is strongly developt, as well as the rib in its course along



FIGS. 189 AND 190.—*Catapleura ponderosa*. Portions of type. ×⅔.

189. Pygal and eleventh peripheral. 190. Section along midline of pygal.

the under side of the costal. As in *C. repanda*, this rib gets nearer and nearer the thickened side of the costal on its way toward the distal end. There is also a rough groove near the proximal end of the front of the ridge; but it is not so conspicuous as in the other species. Moreover, it is seen only on the two costals supposed to belong to the second pair.

On none of the costals or peripherals are there observed any remains of sulci, to mark the limits of the horny scutes. The costals are markt by very distinct branching vascular grooves.

There is present a fragment of a plastral bone, which was interpreted by Cope as the hinder part of the left hypoplastron. The writer finds it impossible to identify the bone satisfactorily. One border is obtuse and 14 mm. thick. The opposite border is thin and irregular.

Only the proximal half of the right humerus is present. The long axis of the head measures 35 mm., the shorter 24 mm. The radial process is missing, but it continued to the head of the bone. The ulnar process lacks much of rising to the level of the head, and the ridge descending from it runs well down on the shaft. The planes of the radial and ulnar processes make with each other an angle of more than 90°. The shaft of the bone is comprest, having a diameter of 15 mm. in the perpendicular plane; of 11 mm. in the horizontal. It is therefore comprest in a manner directly opposite to that of the *Cheloniidæ*.

The femur is that of the right side and lacks the distal end. The portion remaining is 93 mm. long; and the whole bone must have been about 120 mm. long. As in the more primitive turtles, the head and the processes resemble those of the humerus. The head has diameters respectively of 23 mm. and 30 mm.

The fibular process rises only to the lower level of the head. The tibial process is broken off. The planes of the two made with each other an angle of more than 90°, and there is a broad fossa between them, open below. The ridge from the tibial process runs far down on the shaft. The least diameter of the latter is 12 mm.

The present species appears to differ from *C. repanda* in having no traces of sulci between the epidermal scutes, in having the ridge formed from the rib on the under side of the costal more strongly developt and more angular, and apparently in having the hinder peripherals more recurved toward their free margins. To judge from the types, *C. ponderosa* was considerably the larger species.

In his description of this species Cope mentions a portion of the mandible which had accompanied the other bones. This bone is now at hand. It consists of the right dentary. The tip of the dentary and the hinder portion of the cutting-border are missing. The break between two dentaries appears to have followed the midline. The length of the symphysis was close to 36 mm. and its hinder end extended back to a line joining the mental foramina. The latter are small. From the symphysis the upper surface of the dentary descends slightly outward, then rises considerably to the cutting-border. The lower side of the dentary is flat for a considerable distance on each side of the midline, then rises in a strong curve to the cutting-edge. The thickness at the hinder end of the symphysis is 11 mm. The jaw is strongly grooved behind. This dentary resembles that described under *O. chelydrinus;* but, having the same width, the latter is thicker and heavier.

Genus LYTOLOMA Cope.

Lower jaw with broad, flat crushing-surface and long symphysis; the tip not beaked. Carapace resembling that of *Caretta caretta* but less pointed behind. None of the anterior peripherals suturally articulated with the costal plates, rib-pits of most of the peripherals in the hinder half of these bones. The eleventh peripheral with pit for rib of eighth costal. Plastron not well known, but believed to have a narrower connection with the carapace than in *Osteopygis*. Limbs not well known, the humerus and femur supposed to have about equal development, with tendencies toward the structure of the same parts in Cheloniidæ.

The type of this genus is *Lytoloma angusta* Cope. This is represented by some peripherals and a lower jaw, all supposed to belong to the same individual. Dr. Wieland has described and figured a considerable portion of a carapace which he referred provisionally to *L. angusta*, but which is here placed with doubts under *L. wielandi*.

A considerable number of species from the Eocene of England and Belgium have been arranged under this genus, after having been assigned variously to *Chelone*, *Euclastes*, *Puppigerus*, *Glossochelys*, *Pachyrhynchus*, *Thalassochelys*, and *Erquelinnesia*. For the discussion of the subject the reader is referred to the original papers. These are cited by Mr. Richard Lydekker in his Catalogue of Fossil Reptilia, part III, page 51.

It is evident, however, that few, if any, of these species really belong to *Lytoloma*. Owen's *Chelone crassicostata*, the palatal view of which is figured by Lydekker (Proc. Zool. Soc. Lond., 1889, pl. vi), under the name of *Lytoloma crassicostatum*, has the choanæ pushed backward to the hinder third of the skull, and the palatine bones meet for a considerable distance behind the vomer. In the article accompanying the figure just cited Mr. Lydekker informs us that Dollo's species originally described under the name of *Pachyrhynchus gosseleti* is identical with Owen's *Chelone crassicostata*. For the genus represented by this species it appears that Dollo's name *Erquelinnesia* will have to be employed.

The skull of Owen's *Chelone planimentum* resembles in general that of his *C. crassicostata*, but its palate appears not to have been described. Nevertheless, the carapace presents several peculiarities. The neurals have the antero-lateral and the postero-lateral sides equal, the ribs present themselves on the under side of the costals as prominent, narrow, and angular ridges, and the peripherals are much more reduced than in *C. crassicostata*. It seems probable that we have here a distinct genus, and for this Seeley's name *Glossochelys* will be available.

Dr. W. B. Clark has publisht (Johns Hopkins Univ. Circ. XV, 1895, No. 4; Bull. U.S. Geol. Surv., No. 141, 1896, p. 59) a mention of some fragments of a large carapace found in the Aquia formation in Maryland, which he supposed might belong to Cope's *Euclastes*. Case

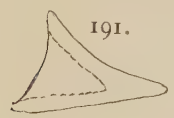
(Geol. Surv. Maryland, Eocene, 1901, p. 97. pl. x, fig. 7) has repeated Dr. Clark's words and figured one fragment. The materials are generically indeterminable.

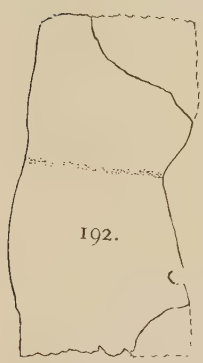
Lytoloma angusta Cope.

Plate 28, figs. 5, 6; text-figs. 191, 192.

Chelone sopita (in part), LEIDY, Smithson. Contrib. to Knowledge, XIV, 1865, p. 105, plate xix, fig. 5.
Lytoloma angusta, COPE, Amer. Naturalist, III, 1869, p. 105 (nom. nud.); Ext. Batrach., Reptilia, Aves N. A., 1869, p. 145, plate xi, figs. 1, 1*b*; Vert. Cret. Form. West, 1875, p. 257.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442.

Cope's first mention of this species was in the American Naturalist, as quoted above, but this mention was made only incidentally and what was said is not sufficient to distinguish either the species or the genus from various other turtles. When he came to describe and figure the species Cope stated that his materials consisted of three peripheral bones, a fragment of a costal, and a lower jaw. He says that the costals and marginals were found at the same time and place as the jaw and probably belong to it. It seems that he regarded the peripherals as the type of the species, and since he figures only one of these, this especially must be taken as the type. That he so regarded the peripherals is evident from the fact that from peripherals alone of this species and *L. jeanesi* he drew all his generic characters. Further proof is afforded by the specimen of the jaw itself, which bears, in Cope's writing, the label "*?Lytoloma angusta* Cope, Birmingham, N. J." In case he had lookt upon the jaw as the type he could hardly have questioned its belonging to the species. It is wholly probable that at least the figured peripheral and the costal belong with the jaw; and until it has been shown that they do not, all may pass as types. These specimens were obtained in the upper greensand beds of the Cretaceous, at Birmingham, near Pemberton, New Jersey. Inasmuch as the jaw is labeled by Cope as coming from Birmingham, it is probable that the specimens were obtained from some marl-pit between the two towns. They are now in the American Museum of Natural History and bear the number 1133.





FIGS. 191 AND 192.—*Lytoloma angusta*. Peripherals of type. ×⅔.

191. Section through fifth peripheral. Pit shown by interrupted line.
192. Supposed second right peripheral.

The figured peripheral (plate 28, fig. 6) is said by Cope to belong to the left side, but on the bone itself he has written "5 R," from which it appears that he regarded it as the fifth of the right side, and such it seems to be. It has a length, along the acute free margin, of 67 mm. A section of the bone is triangular, and therefore it shows three faces (fig. 191). The visceral face is 22 mm. wide, somewhat concave, and contains in the hinder half of the bone a deep conical pit for the rib-end of the third costal. The upper face is slightly concave at right angles with the free border, 22 mm. wide at the anterior end, 29 mm. at the posterior. The inferior face is slightly convex and 32 mm. wide at each end.

Another peripheral (fig. 192) is markt by Cope "?2 R." It has a length of 70 mm., a thickness at the visceral face of 16 mm. at one end and 13 mm. at the other. The upper and lower faces are somewhat convex. In the free border there is a broad emargination. At the bottom of this emargination the bone is 28 mm. wide. At one sutural end the width is 34 mm. There is no rib-pit in the visceral face. The peripheral, supposed by Cope to be the fourth, is not now with the other bones.

The fragment of costal has a width of 47 mm. near the sutural border for the neural. At the middle of the width the thickness is 10 mm.; at the sutural border it is about 4 mm. As stated by Cope, there is present the sulcus bounding one of the vertebral scutes. From a comparison with the figure publisht by Wieland, and here reproduced (fig. 196), this costal is believed to be the sixth of the right side. The outer angle of the vertebral scute is placed near the hinder sutural border of the bones, at a distance of 50 mm. from the neural.

The lower jaw (plate 28, fig. 5) is of the greatest interest. It is considerably eroded and does not lend itself well to illustration. It is remarkable for the great length of the symphysis,

52 mm., and for the flatness of the triturating surfaces. An unimportant part of the tip of the jaw is broken off. There was certainly no upturned beak, such as there must have been in *Rhetechelys platyops* (Cope); nor was there a cutting-edge that rose much above the triturating surface. The lower surface of the jaw is likewise very flat, rising abruptly toward the free borders. The thickness at the hinder end of the symphysis is 18 mm.; at a distance of 25 mm. behind the tip the thickness is 16 mm. The coronoid process rises 40 mm. above the bottom of the ramus. The rami are thoroly co-ossified. There are no other bones of the jaw present except the right coronoid, which is crowded to the inside of the coronoid process of the dentary.

At the tip of the jaw the borders of the dentaries diverge at an angle slightly greater than a right angle. At the fronts of the fossæ for the masseter muscles the width is 91 mm.; at the hinder end of the dentaries it is 110 mm. The fossæ just mentioned are large and deep. That part of each on the dentary is 40 mm. long and 26 mm. high. At the front of each fossa is a mental foramen. A line passing from one of these to the other falls 12 mm. in front of the hinder end of the symphysis.

The fragmentary skull materials described by Wieland provisionally under the name of *L. angusta* (Amer. Jour. Sci., XVIII, 1904, p. 184, 185, figs. 1, 2) are here made the types of a new species. The carapace which that author has also referred to *L. angusta* (op. cit., p. 187, pls. vi–viii) doubtfully belongs to it. In case the peripheral regarded by Cope as the second really belongs with the type, the carapace described by Wieland certainly does not belong to the species to which he has assigned it, for that peripheral in the type has the border emarginate. Furthermore, the fifth peripheral of *L. angusta* does not resemble closely any of those of the carapace described by Wieland. It resembles most nearly the fifth of Wieland's specimen, but differs in relative length and width; apparently also in the position of the pit for the rib. Only future discoveries can decide this point.

The bones figured by Leidy (as cited in the synonymy) under the name of *Chelone sopita* have been referred by Cope to *Lytoloma angusta*. They appear not to agree with any species of *Osteopygis* in that they are much longer than wide, have the sulci crossing the middle of the length and have the pits well toward the rear end of the bone.

Lytoloma jeanesi Cope.

Figs. 193–195.

Propleura jeanesii, COPE, Cook's Geol. of New Jersey, 1868 (1869), p. 735 (nom. nud.).
Lytoloma jeanesii, COPE, Ext. Batrach., Reptilia, Aves N. A., 1869, p. 145; Vert. Cret. Form. West, 1875, p. 257.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.

Of this species Cope studied what he regarded as portions of 2 individuals. Of the first, discovered in the upper bed of Cretaceous greensand, near Barnesboro, Gloucester County, New Jersey, there were secured only the nuchal bone and the first peripheral. Cope appears to have lookt upon this lot as the type of the species. Where these bones are now is not known. The second individual was obtained in the same bed of greensand, at Hornersville, New Jersey. This specimen, or most of it, is now in the American Museum, where it has the number 1473.

The nuchal bone which belonged to the first-named individual was described by Cope as resembling an ordinary peripheral, differing entirely from the nuchal of *Chelydra* and *Chelone*. The anterior border appears to have been obtuse. Its length, from side to side, is not given; the width is stated to have been 16.5 lines (about 34 mm.). The nuchal scute which it bore is said to have been about 18 mm. wide. The bone is described as having joined the first peripheral by a coarse gomphosis, the process coming from the first peripheral. There was also a sutural border for union with the first neural; but we are not told whether or not the nuchal articulated with the first costals.

The first peripheral is described as having a free inner border, a condition showing that it did not articulate with the first costal. Its suture with the nuchal was straight; that with the second peripheral had the entering angle seen in *Osteopygis sopitus*, etc. The width of the first peripheral is given as 15.5 lines, about 32 mm. This width was three-fifths of the length, therefore about 53 mm.

Of the second individual examined by Cope the first peripheral is at hand (fig. 193). It has an obtuse free outer and an acute free inner margin. The thickness near the proximal end and the outer border is 12 mm. At the hinder end (fig. 194) the thickness is somewhat less. On the distal half of the bone and near the free margin, or rather, forming the free margin, is a low sharp ridge, at which the upper and the lower surfaces meet. The suture with the nuchal is oblique, running from the inner border forward and toward the midline, then forward and outward, then again forward and toward the midline. The end of the bone was somewhat overlapt by the nuchal. The length along the free outer border is about 65 mm.; along the free inner border, about 40 mm.; from one extremity to the other, 80 mm. The greatest width is 35 mm.; that near the hinder end is 27 mm.

The peripheral regarded by Cope as the sixth (fig. 195) has a length of about 100 mm. A part of the free border is broken away. The bone is triangular in section, presenting thus three faces. The inner or visceral face is quite concave the whole length and has in the hinder half a deep conical pit for the end of a rib. The bone is about 30 mm. wide. The lower face is slightly concave and is 30 mm. wide. The upper face has a width of from 35 mm. to 38 mm. and it is nearly plane. According to the present interpretation, the bone belongs to the right side. All of the free borders are acute, especially the upper inner, and in none of them is there any emargination.

FIGS. 193–195.—*Lytoloma jeanesi*. Peripherals. ×⅔. No. 1473 A. M. N. H.

193. Right first peripheral.
194. Section near distal end of first peripheral.
195. Section of sixth? peripheral. Pit shown by interrupted line.

Accompanying the bones above described is a fragment of a costal which agrees in its dimensions with the one mentioned by Cope. Its width is 90 mm., while the thickness thru the middle of the width is 11 mm. Cope states that the costals showed no sculpture. However, the present costal has its surface broken by numerous pits of varying form and size, resembling thus closely the costals of *Osteopygis erosus*. It is probable that the bone belongs elsewhere.

The peripheral described above as probably the sixth differs so much from the fifth of *L. angusta* that a distinct species is clearly indicated. The ratios of width to length in the two bones are very different. The width of the peripheral of *L. angusta* is contained in the length about two and a third times; while in that of *L. jeanesi* the width is contained in the length three and a third times. The results are equally decisive in case both peripherals should happen to be fifths or sixths. It is wholly probable that neither of them can belong farther backward in the series.

The various measurements of this bone show that the carapace described by Wieland can not belong to *L. jeanesi*.

Lytoloma wielandi sp. nov.

Plate 28, figs. 7, 8; plate 29, fig. 1; text-figs. 196, 197.

Lytoloma angusta?, WIELAND, Amer. Jour. Sci. (4), XVIII, 1904, p. 183, plates vi–viii, text-figs. 1–3; Ibid., XX, 1905, p. 333, fig. 5.

Dr. George R. Wieland has, with exprest doubts, referred some lower jaws, the front of a skull, and a carapace of a *Lytoloma* to *L. angusta*. His specimens are in the Yale University collection. The skull bones were secured by Professor O. C. Marsh from the upper Cretaceous greensand bed at Hornerstown, New Jersey. The carapace came from Barnesboro. It seems evident that these remains do not belong to the species to which they have been assigned, and they are here made the types of a new species, named in honor of Dr. Wieland.

In case it shall hereafter be discovered that more than a single species is represented by these bones, the lower jaw figured by Wieland shall be regarded as the type of *L. wielandi*.

That this lower jaw is not identical specifically with that regarded as belonging to the type of *L. angusta* appears from the following considerations:

(1) The angle subtended by the cutting-borders of the jaw of *L. angusta* forms at least a right angle; in *L. wielandi* this angle is 80 degrees.

(2) In *L. angusta* the lateral outlines of the jaw continue outward and backward in nearly straight lines to the mental foramina; in *L. wielandi* the borders are deflected more nearly backward at a considerable distance in front of these foramina.

(3) In *L. angusta* a line drawn from one foramen to the other falls 12 mm. in front of the hinder end of the symphysis; in *L. wielandi* it falls at the hinder end of the symphysis.

(4) In *L. angusta* the descent from the summit of the coronoid is much more abrupt than in the other species considered. In the former species the height of the coronoid process is 77 per cent. of the length of the symphysis; in the new species, only 60 per cent.

(5) The tip of the jaw of *L. wielandi* appears to have been more upturned, more acute, and in every way more beak-like than in *L. angusta*.

Differences so great as indicated above in two jaws whose symphyses are respectively 52 mm. and 42 mm. can hardly be attributed to differences in age or sex. At least, so great differences do not appear in a number of jaws of the loggerhead turtle, to which the jaws of *Lytoloma* have great resemblances. In a huge skull of the loggerhead, the length of which from snout to occipital condyle is 230 mm., the line joining the mental foramina falls at the hinder end of the symphysis, while it falls only 12 mm. behind the symphysis in a young specimen whose skull is only 130 mm. long. As to the lateral outlines of jaws, the elevation of the coronoids, and the form of the tip, there is not much difference among specimens of middle and large sizes. The angle subtended by the outlines of the anterior portions of the lower jaws of *Caretta* may, however, vary as much as in the case of *L. angusta* and *L. wielandi*.

The width of the jaw forming the type of *L. wielandi*, taken at the mental foramina, is 66 mm.; taken at the hinder ends of the dentaries, 75 mm. The length of the symphysis is 42 mm. The greatest thickness at the symphysis is 11 mm.

The front of the skull figured by Wieland agrees in size and in the angle made by the borders of the upper jaws with the lower jaw just described. A comparison made with the jaw of the loggerhead indicates that the skull of which it formed a part had a length of about 156 mm. Seen from above or below, it resembles considerably the same part in the loggerhead. Seen from the side, the tip of the snout is much more deprest than in the loggerhead, a condition due probably to the little-developt cutting-edge of *Lytoloma*. Plate 28, fig. 7, represents Wieland's type skull seen from above; plate 28, fig. 8, as seen from below; and plate 29, fig. 1, as seen from behind. These figures are reproduced from drawings made for Dr. Baur in 1888.

The orbit was large. The prefrontals joined along the midline for a distance of at least 12 mm. and to a line crossing the skull considerably behind the fronts of the orbits. In *Rhetechelys platyops* (Cope) the prefrontals were parted by the frontals to a line considerably in front of the orbits.

The external nasal opening has its transverse and its longitudinal dimensions each 20 mm. The snout as seen from above is not acuminate, as it was in *Rhetechelys platyops*.

The vomer appears, as in *Rhetechelys platyops*, to have wholly separated the horizontal plates of the palatines. It has a length of 33 mm. and a width of 20 mm. The width of the perpendicular plate of the vomer, between the narial passages, is 11 mm. The choanæ are thrown well backward, but it is doubtful whether they were pushed backward as far as they were in *R. platyops*, to a line joining the hinder borders of the orbits.

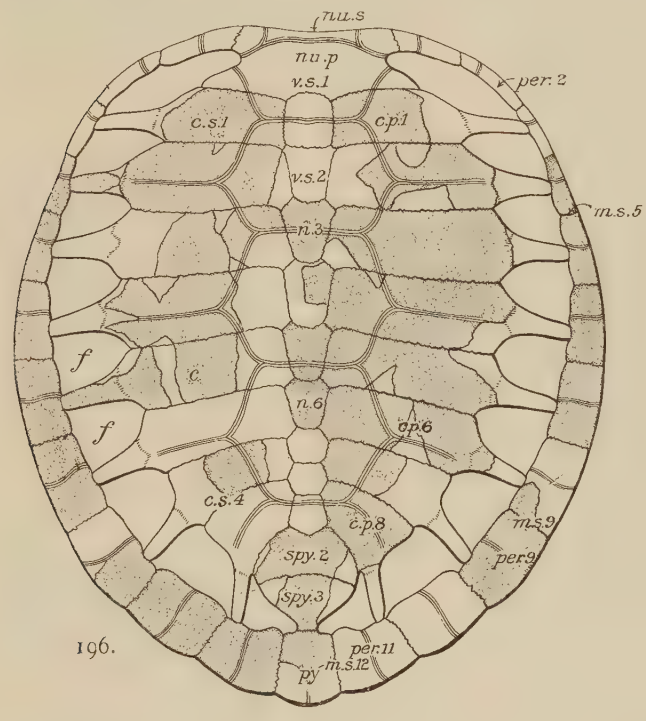
There is no certainty that the carapace described by Dr. Wieland belongs to the present species, and it is so referred only because it seems to belong neither to *L. angusta* nor *L. jeanesi*.

This carapace (fig. 196) was received by Prof. O. C. Marsh, May 1, 1869, it having been sent to him from the upper greensand bed of the Cretaceous, near Barnesboro, New Jersey.

The estimated length of the carapace is 580 mm.; the greatest breadth, 530 mm. In general, it resembles the carapace of the loggerhead, but it is far less pointed behind, a con-

dition showing that the turtles of this genus had not yet become seafarers. At Dr. Wieland's disposal, belonging to this specimen, were wholes or parts of the third, fourth, fifth, and sixth neurals, wholes or parts of two suprapygals, wholes or parts of all the costals of the right side and of most of those of the left side, wholes or parts of all the peripherals of the left side behind the third and of most of those of the right side behind the third, and a portion of the pygal. The nuchal and the three anterior pairs of peripherals were missing.

The neurals are hexagonal, with the broader end forward, and nearly as wide as long. The third is 44 mm. long and 44 mm. wide; the fifth 41 mm. long and 41 mm. wide; the sixth 41 mm. long and 34 mm. wide. They are each 6 mm. or 7 mm. thick. The anterior suprapygal



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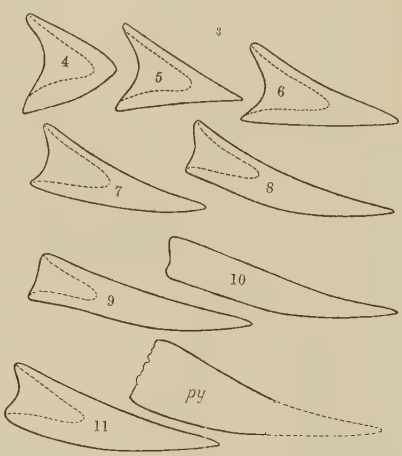

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FIGS. 196 AND 197.—*Lytoloma wielandi.* Carapace and sections of peripherals of type.

196. Carapace. ×⅓. After Wieland. *c. p.* 1, *c. p.* 6, *c. p.* 8, first, sixth, and eighth costals; *c. s.* 1, *c. s.* 4, first and fourth costal scutes; *f*, lateral fontanels; *m. s.* 5, *m. s.* 9, *m. s.* 12, fifth, ninth, and twelfth marginal scutes; *n.* 3, *n.* 6, third and sixth neural bones; *nu. p*, nuchal bone; *nu. s*, nuchal scute; *per.* 2, per. 9, *per.* 11, second, ninth, and eleventh peripheral bones; *py*, pygal; *spy.* 2, *spy.* 3, second and third suprapygal bones; *v. s.* 1, *v. s.* 2, first and second vertebral scutes.

197. Sections through middle of length of peripherals. ×½. The numeral on each indicates the position of the bone. The dotted line indicates the pit. *py*, section along middle of pygal.

is 37 mm. long and 80 mm. wide; the posterior, 60 mm. long and perhaps 80 mm. wide. The posterior articulated narrowly with the pygal.

The costals varied in width from 50 mm. to 60 mm. It is evident that the first costals articulated with the nuchal at its outer extremities. Cope states that the nuchal of *L. jeanesi* articulated with the first neural, but he says nothing about the articulation with the first costals. The latter species possest a nuchal extremely narrow, little wider than the first peripheral, and therefore quite unlike that shown in Dr. Wieland's restoration. However, as Dr. Wieland's specimen lackt the nuchal and the anterior peripherals, we do not know their structure and connections.

Peripheral.	Length.	Width.	
		Upper face.	Inner face.
4	55	25	24
6	72	43	22
8	80	56	15
10	75	60	13

The eighth costal had its rib-end thrown back, so as to enter a pit in the eleventh peripheral, a feature common in the Cheloniidæ. As in the Cheloniidæ, too, there were extensive fontanels between the distal ends of the costals and the peripherals.

The peripherals have each three faces, an inner or visceral, a superior, and an inferior. Each of them, from the fourth to the ninth inclusive, has a pit for the reception of the end of a rib. Fig. 197 from Wieland represents sections of these peripherals. It will be observed that they grow broader and thinner from the front of the carapace. The dotted line in each represents the depth of the pit. The table, p. 159, gives the dimensions of some of the peripherals.

Dr. Wieland has described certain ossicles intercalated between the peripherals along the free borders of his specimen. He suggests that these are a part of the disappearing osteodermal covering of primitive turtles.

The carapace was covered with horny scutes, which have left distinct impressions of the sulci on the various bones. There were, so far as appears, 5 vertebral scutes, 4 pairs of costals, and probably 12 pairs of marginals and a nuchal. The vertebrals are strongly angulated laterally where the sulci running down between the costals are given off. The table herewith shows the dimensions of three vertebral scutes.

Vertebral.	Length.	Width.
2	100	145
3	110	135
4	114	150

How high on the costal bones the marginal scutes rose can not be determined.

There were preserved with this carapace some fragments of the plastron, but not enough to permit a restoration of it. Wieland regards the plastron as having been more reduced than it was in *Osteopygis*, but otherwise much like it. Small pits in the hinder half of the lower inner free margin of the fourth peripheral show that the hyoplastron extended forward only to it. There are no pits to show how far backward the hypoplastron extended.

The reasons for regarding this carapace as distinct from that of *L. angusta* are presented under the latter species.

Genus ERQUELINNESIA Dollo.

Pachyrhynchus, Dollo, Bull. Mus. roy. d'Hist. nat. Belgique, 4, 1886, p. 130 (preoccupied).
Erquelinnesia, Dollo, Geol. Magazine (3), iv, 1887, p. 393.

Skull resembling that of *Caretta caretta*, but more elevated and descending more rapidly in front of the orbits. Palate flat, bounded by low cutting-edges, and extending backward to the hinder half of the roof of the mouth. Choanæ in the hinder half of the roof of the mouth, their anterior boundary formed by the palatines, which have met behind the palatal plate of the vomer. Lower jaw not beakt. Shell resembling that of *Caretta*, but more rounded behind.

Type: *Erquelinnesia gosseleti* Dollo = *Chelone crassicostata* Owen.

For the structure of the palate of this genus the reader is referred to Mr. R. Lydekker's figure of *Lytoloma crassicostatum* (Proc. Zool. Soc., London, 1889, plate vi). This figure shows that the choanæ are placed in the posterior third of the cranium and that the palatal plates of the palatine bones meet each other in the midline behind the vomer and beneath the narial passages. In the article accompanying this plate Mr. Lydekker states that Dr. Dollo's *Erquelinnesia gosseleti* is identical specifically with Owen's *Chelone crassicostata*. For reference to other views of the skull and to figures of the carapace of this species, and to the literature, the reader is referred to Lydekker's Catalogue of Fossil Reptiles, part iii, 1889, page 60. On page 26 of this work is presented a figure of the humerus of *E. crassicostata*. It is evident that the members of the genus had not yet developt a limb adapted for life on the open sea.

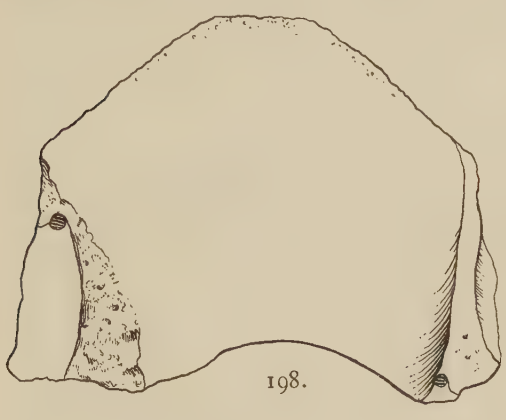
The following species is assigned provisionally to *Erquelinnesia* on account of the great length of the symphysis of the lower jaw. This seems to indicate that the choanæ were located far toward the rear of the skull, so far that the palatines must have met behind the vomer. It is probable that in *Osteopygis* the choanæ were not removed so far toward the rear of the skull.

Erquelinnesia molaria sp. nov.

Figs. 198, 199.

This species is based on a lower jaw which is found in the collection of the Academy of Natural Sciences of Philadelphia. It is labeled as being *Lytoloma platyops*, as having been presented by Rev. L. H. Lighthipe, and as having been secured at Birmingham, New Jersey. It has, therefore, been collected from the upper bed of the Cretaceous greensand.

This jaw (figs. 198, 199) is remarkable for the great length of the symphysis, this length considerably exceeding that of *Lytoloma angusta*. The width of the jaw, at the mental foramina, is 88 mm.; at the hinder ends of the dentaries, 100 mm., dimensions almost exactly those of the jaw belonging with the type of *L. angusta*. The length of the symphysis is 65 mm., that of the jaw of *L. angusta* being 52 mm. In the latter species the hinder end of the symphysis falls 12 mm. behind the line joining the mental foramina; in *E. molaria* it falls 22 mm. behind that line. The triturating surface is flat to near the inconspicuous cutting-edges, to which it ascends. The lower surface of the jaw also is flat, ascending rather abruptly to the cutting-edges. Anteriorly the lower surface approaches gradually the upper surface at the sharp-edged tip of the jaw. The outline of this tip is truncated and about 20 mm. wide. The coronoid process rises about 33 mm. above the bottom of the ramus, and the descent from it toward the tip of the jaw is gradual. The masseter fossa is large.



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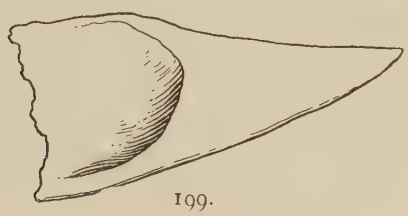


199.

FIGS. 198 AND 199.—*Erquelinnesia molaria*. Lower jaw forming the type. $\times\frac{2}{3}$.

198. Upper view of jaw. 199. Side view of jaw.

The greatest thickness of the triturating surface is near the hinder end of the symphysis. The angle between the borders of the jaw, in front, is considerably more than a right angle.

This jaw can not be that of *Rhetechelys platyops* (Cope) for at least two reasons. The angle between the lateral borders is too great to fit the upper jaw of *R. platyops*. The type of the latter species belonged to an individual about twice as large as the possessor of the jaw here described; and, if they belonged to the same species, the angle of the jaw of the type of *R. platyops* ought to be the larger. Again, in case the present jaw had belonged to *R. platyops*, the hinder end of the symphysis would have fallen a distance behind the choanæ equal to the length of the palatal plate of the vomer. The results of this would have been that a large part of the triturating surface of the lower jaw would have had no surface to oppose it and it would have been applied against the choanæ, thus interfering with breathing.

From both *Lytoloma angusta* and *L. wielandi* this species differs in the greater length of the symphysis and in the smaller angle between the borders of the jaw.

Genus RHETECHELYS nov.

Skull broad and deprest. Temporal region widely rooft over. Triturating surface of upper jaw broad, involving the maxillæ, the palatines, and the vomer. Choanæ near the middle of the roof of the mou h; the palatines not meeting behind the vomer. A pit between the premaxillæ for the reception of the upturned beak of the lower jaw. Shell and limbs unknown.

Type: *Euclastes platyops* Cope.

This genus differs from the species of *Lytoloma* (to which genus it has been referred since the discovery that the name *Euclastes* is preoccupied) in having had the tip of the lower jaw furnisht with an upturned beak. The existence of this is inferred from the presence of a deep depression between the palatal plates of the premaxillæ and an interruption of the bone. Similar conditions are found in the skull of *Macrochelys*. *Osteopygis*, *Lytoloma*, and *Erquelinnesia* all have lower jaws with broad, flat triturating surfaces, but in none of them do we find any traces of a beak.

The only known species of the genus was a large and powerful animal, whose skull equaled in size that of the largest specimens of the living loggerhead.

Dr. W. B. Clark has referred provisionally (Johns Hopkins Univ. Circ., XV, 1895, No. 4; Bull. U. S. Geol. Surv., 141, p. 59) some fragments of a large turtle to *Euclastes*. One of these fragments has been again mentioned and figured by Dr. Case in the Eocene volume of the Geological Survey of Maryland (p. 97, plate x, fig. 7). The fragment is not susceptible of generic determination.

Rhetechelys platyops (Cope).

Plate 29, figs. 2, 3.

Euclastes platyops, COPE, Proc. Acad. Nat. Sci. Phila. 1867, p. 41; Cook's Geol. New Jersey, 1868 (1869), p. 735; Amer. Naturalist, III, 1869, p. 89; Ext. Batrach., Reptilia, Aves N. A., 1869, p. 149, plates vi, vii, fig. 9; Vert. Cret. Form. West, 1875, p. 259.

Lytoloma platyops, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442.—WIELAND, Amer. Jour. Sci. (4), XVIII, 1904, p. 185.

?Propleura sopita, COPE, Ext. Batrach., Reptilia, Aves N. A., 1869, p. 140 (Harrisonville specimen).

All that we know at present regarding this species is what is to be derived from the type skull. This is in the collection of the Academy of Natural Sciences at Philadelphia. It was found in a coarse granular limestone, at Hurffsville, Camden County, New Jersey. This deposit belongs to the Upper Cretaceous and was regarded by Cope as equivalent to the Fox Hills group. The species formed the type of Cope's genus *Euclastes*, a preoccupied name.

The skull was a large one, the total length being estimated by Cope as 11 inches, about 280 mm.; but this must have included the supraoccipital process. At any rate, the length was equal to that of the largest specimens of *Caretta*. The occipital condyle is missing, but the length from the premaxillæ to this condyle must have been close to 200 mm., perhaps a little more. The width, a short distance behind the orbits, is 220 mm. From this widest part the aiteral outlines converge rapidly to the pointed snout. Beneath the orbit the outlines are slightly concave. The angle included between the borders of the maxillæ is somewhat less than a right angle. The roof is broad and deprest, the frontal region being flat. The slope from the rear to the nasal opening is only slightly sinuous. There is no such sudden descent from the orbits to the premaxillæ as we see in the species of *Glossochelys*. The temporal region was broadly rooft over, as in *Caretta*, but extended backward still further. The various bones appear to have been disposed about as in the living genus mentioned.

The orbits look outward, forward, and upward. The upward inclination exceeds that of *Caretta*. The greatest diameter of the orbit is 63 mm. The least interorbital width is about 50 mm. The frontal bones are more produced forward than in *Caretta*, their suture measuring 55 mm. They are excluded from the rim of the orbits by the union of the postfrontals with the prefrontals. The latter bones meet along the midline a distance of 12 mm.

The nasal opening has a width of 30 mm. It looks forward and strongly upward. As in other *Cryptodira*, the prefrontals send downward on each side a column of bone to the vomer.

The roof of the mouth resembles in general that of *Caretta*, but there are important differences. The cutting-edges of the maxillæ are only feebly developt, descending but little below the level of the grinding surface. This surface is formed by the union of the palatal plates of the premaxillæ, maxillæ, vomer, and palatines. It extends backward a distance of nearly 100 mm. from the premaxillæ. It is somewhat concave on each side of the vomer and in the premaxillary region. In the roof of the mouth the maxillæ are each 41 mm. wide; the palatines about 26 mm. The vomer is 50 mm. long and 28 mm. wide.

The occipital condyle is missing, but the choanæ fall within the anterior half of the length to the roof of the mouth. They are bounded laterally by the palatines and anteriorly by the vomer, the edge of this being 98 mm. behind the tip of the snout. They are thus quite different from those of the species of *Erquelinnesia*. The palatal openings of the temporal fossæ are broader than long. The borders of the pterygoids were strongly emarginated.

Between the anterior ends of the premaxillæ is a perforation supposed to be for the reception of a hook on the lower jaw, as in *Macrochelys*.

Professor Cope supposed that the whole length of the animal which possest this skull was a little over 6½ feet; but it is not safe to estimate the size of a turtle from the size of the head. Nevertheless, it must have been a large and formidable brute. Probably it haunted the coasts of the Cretaceous seas, betaking itself at times to some distance from the shore.

Its food has been supposed to have been hard-shelled animals, such as mollusks, which were crusht between its mill-stone-like jaws. The possession of a hookt beak like that of the alligator-snapper suggests, however, that the animal may have been accustomed to the capturing of a more active prey, such perhaps as fishes.

Cope, as cited in the synonymy above, referred certain bones obtained at Harrisonville, Salem County, New Jersey, to *Propleura sopita*. These consisted, as he says, of 2 peripheral bones, part of a costal, half a femur, and 2 phalanges. This lot is in the American Museum and is found to include three peripherals, a fragment of a costal, and the distal end of a femur. The foot bones are missing. The number is 2361. These bones quite certainly do not belong to *Osteopygis*. In all specimens known to belong to the latter genus the pit for the rib-end is placed at the middle of the length of the peripheral or not far behind it. Only in the tenth peripheral is it placed close to the hinder end of the peripheral. In the bones of the Harrisonville specimen the pit is placed far backward. Since *Rhetechelys platyops* was found in the same limestone not many miles distant, the bones found at Harrisonville are referred provisionally to the species just named.

One of the peripherals appears to be the left first. Its length is 85 mm.; its height 48 mm.; the thickness of the obtuse free border, 19 mm. in front. The articulation with the first costal was not strong and apparently only along the anterior end of the bone. It is not certain that any part of the first vertebral scute descended on this peripheral. Another peripheral is probably the left fifth. The anterior end is broken off, but the length must have been about 110 mm. From the hinder end to the intermarginal sulcus is 60 mm. The height of the upper face, at the sulcus, is 62 mm.; the lower face, 53 mm.; the inner face, 50 mm. The pit is in the hinder third of the bone. The upper face is slightly concave; the lower slightly convex; the inner concave. The remaining peripheral is probably the seventh. Cope regarded it as the eighth. Most of the outer border is broken away. The length is 95 mm.; the height, 79 mm.; the thickness of the costal border, 28 mm. in front, 24 mm. behind. The upper surface is somewhat concave; the lower, convex; The circular rib-pit is almost wholly in the hinder third of the inner face. The piece of costal is 7 mm. thick at the sutural border. All these bones are smooth, but markt by vascular grooves. The width of the femur at the distal end is 45 mm. The diameter of the shaft is 19 mm. The bone was considerably bent.

Family TOXOCHELYIDÆ Baur.

Skull somewhat deprest. Temporal region extensively rooft. Quadrate notcht for the columella. Choanæ situated well forward; not underfloored by the palatines. Palatines extending forward to the vomers and forming the outer boundaries of the choanæ. Carapace with eleven pairs of peripherals, in addition to the nuchal and pygal. Nuchal not furnisht with costiform processes. Epidermal shields present. Plastron loosely articulated with the carapace, not extending forward to the third peripheral and backward hardly to the eighth. Fore foot with at least 2 claws; the phalanges furnisht with condyles; the limb as a whole resembling that of the Trionychidæ.

Genera 2, *Toxochelys* and *Porthochelys*. With these may be included provisionally the insufficiently known genus *Cynocercus*.

The writer excludes the members of this family from the Cheloniidæ especially because the fore limb had not yet become developt into a flipper like that of the modern sea-turtles. The humerus offers scarcely an approach to that of the sea-turtles. Nor was the hinder limb nearly so much reduced as in the latter. The limbs were probably greatly like those of the Trionychidæ. That the anterior limbs were not habitually employed in swimming appears to be shown by the fact that the shell was not excavated over these limbs as it is in the Cheloniidæ.

Genus TOXOCHELYS Cope.

Skull longer than broad. No nasal bones. Carapace with large lateral fontanels. None of the peripherals in contact with the disk of the carapace. Midline with prominent carina, rising at intervals into tubercles, some of which are distinct bones. Tail with a series of comprest tubercles above. Plastron with median and lateral fontanels.

Type: *Toxochelys latiremis* Cope.

The known species of this genus, 7 in number, are from the Niobrara deposits of Kansas. All these species except *T. bauri* Wieland are based on parts of the skull; and this portion of the skeleton is more commonly found than even the carapace, a rare circumstance in the case of fossil turtles. However, the greater part of the shell and limbs is known from two or three of the species.

From studies made on this genus some years ago (Field Columb. Mus. Pubs., Zool. ser. 1, 1896, p. 101) the writer concluded that the position of this genus is near the Cheloniidæ, but with evident relationships to the Chelydridæ, constituting a distinct family, which is to be called, as Baur has proposed, Toxochelyidæ. This conclusion has been confirmed by more recent investigations made by Case, Wieland, and the present writer. The resemblances to *Chelydra* are to be found especially in the anterior portion of the skull, in the structure of the carapace, in the humerus and femur, and in the tuberculated tail.

The roof of the mouth is practically identical with that of *Chelydra* except that the palatine extends forward to articulate with the vomer in front of the choanæ. The masticatory surfaces of the two are equally flat, the cutting-edges of the maxilla are low in both, the choanæ are placed well forward and are not underfloored by processes from the palatines; and there are in both genera large palatine foramina. On the other hand, as in the Cheloniidæ, the tympanic cavity has not yet entered the squamosal bone, the notch in the hinder face of the quadrate remains open, and the back of the skull is extensively rooft over by the parietal, postfrontal, and squamosal bones. As regards the carapace, it is evident that the nuchal resembles more that of the Cheloniidæ, it having had no such long costiform processes as we find in the Chelydridæ. Again in the presence of a surface for articulation with the spine of the eighth cervical, as determined by Wieland, the nuchal resembles more that of the Cheloniidæ. There were 11 peripherals, as in *Chelydra* and most Cheloniidæ. The costal plates were less developt than in the Chelydridæ, even less than in any living Cheloniidæ, so that there are extensive fontanels at the sides of the carapace. The elements in the midline appear to have resembled more those of *Chelydra*, but there were peculiarities. There was a prominent carina, which at intervals rose into comprest tubercles. The latter were distinct bones, which rested on the contiguous portions of two neurals or suprapygals. The first rested on the first neural; the second, on the second and third; the third, on the fourth and fifth; the fourth, apparently on the seventh and eighth or on the eighth peripheral and the first suprapygal. If the fourth was placed on the seventh and eighth neurals a fifth tubercle rested on the second suprapygal. Wieland has named these ossicles "epineural spines," but they are hardly to be thus homologized with the epineural bones of fishes. They were continued backward on the upper surface of the tail as a series such as we find on the tail of *Chelydra*. The position of all these, except the most anterior, was described and figured by the writer in 1898 (Amer. Naturalist, XXXII, p. 936, fig. 2). Dr. Case was the first to observe the presence of one of these bones. Wieland in 1905 (Amer. Jour. Sci., XX, p. 331) describes a small bone on the first neural which probably represents the first of this series of ossicles. Wieland in 1896 (Amer. Jour. Sci., II, p. 400) suggested that *Archelon* may have borne a series of dorsal spines; but as those spines were believed to be horny and their existence only hypothetical, their discovery has nothing to do with that of the bony spines. The writer has elsewhere presented his reasons for believing that these tubercles represent the original dermal skeleton of the Testudines, now retained only by *Dermochelys* (Amer. Naturalist, XXXII, 1898, p. 929).

The writer presents here a description and figures (plate 30, figs. 1, 2) of a portion of a carapace belonging to an undetermined species of this genus, remains which were collected by Mr. H. T. Martin in Gove County, near Monument Rock, Kansas. Since this carapace was not accompanied by any part of the skull, it was not possible to identify it specifically.

The specimen furnishes 15 peripherals, some fragments of costals, and a series of median elements, of which 2 appear to be suprapygals. The median line of the carapace was occupied by a strong and sharp keel. Anteriorly the right and left sides of this keel make about a right angle with each other, but posteriorly they meet at a smaller angle, so that the keel is high and sharp. At intervals the keel rises into comprest tubercles. These were in all cases originally distinct bones, but most of them, especially posteriorly, have become co-ossified with the supporting bones. The first neural appears to be wanting, together with the nuchal. There is present 1 neural which does not furnish satisfactory contact with any of the others. There

are 3 others joined in their natural relation, and 3 more joined together and the hindermost united with the suprapygals. The single neural must belong in front of all the others. It can not be the first one, because it is too thick in front for the nuchal, in case this was as thin behind as in the genus generally; also because it is not crost by the sulcus separating the first from the second vertebral scute. It can hardly be anything else than the second neural. At the hinder end of the upper surface there is a half-facet for another bone, one of the series of ossicles mentioned above. The neural which is regarded as the third has on its anterior end a half-facet which completes the one on the supposed second neural. Behind this facet is a sulcus, believed to be the one which divides the first from the second vertebral scutes.

The fourth neural has no tubercle of its own, but its hinder end supported a small part of the tubercle which belongs to the fifth neural. This tubercle has a length of 20 mm. Behind it is the sulcus which passes between the third and the fourth vertebral scutes. The tubercle is wholly co-ossified with the bones on which it rests, but there are traces of the sutures. The sixth neural is sharp along the midline, while its sides slope steeply, like a high-pitcht roof. The seventh neural is short and closely joined to the eighth. A long and strongly comprest tubercle occupies nearly the whole length of both these neurals and appears to be co-ossified with both, only traces of the sutures remaining.

The suprapygals are co-ossified. The first is sharply rooft, while the next one has a rather high and comprest tubercle. The anterior suprapygal appears to have been expanded on each side, but the expansions are broken away. The sulcus between the fourth and the fifth vertebral scutes doubtless crost behind the tubercle on the second suprapygal. The pygal is represented in plate 30, fig. 1. Its height is 14 mm.; its width from side to side, 27 mm. Its upper, or anterior, border appears to have articulated with a suprapygal which is now missing. The upper surface of the pygal is longitudinally grooved, while the inferior has a more extensive longitudinal channel. This pygal is quite different from that of the type of *T. stenopora*. The dimensions of the neurals and suprapygals are shown in the accompanying table.

Element.	Length.	Width.
2	27	25
3	28	23
4	18	22
5	28	24
6	22	20
7	13	18
8	10	15
1st suprapygal	24	..
2d suprapygal	31	13

It is evident that there were 11 pairs of peripherals, as in most turtles. The two anterior are narrow and thin. These are followed by 4 others which are thicker and broader, and these again by others which are thin. The table gives the dimensions of the peripherals present. The width is taken at the front end.

The anterior end of the first peripheral is oblique for articulation with the nuchal. The third and the succeeding peripherals to the ninth inclusive have each a pit for a corresponding rib-end. The tenth has no pit. The eleventh is not present. Since the hinder end of the tenth peripheral is 19 mm. wide and the articular end of the pygal only 12 mm. wide, it follows that the eleventh was considerably wider at one end than the other. All the peripherals are crost by shallow sulci.

Dr. Wieland has represented (Amer. Jour. Sci., XX, 1905, p. 335, fig 6; here reproduced as fig. 229) the rib-end of the eighth costal as entering a pit in the anterior end of the eleventh peripheral. The end of the rib was not present and it is stated that the rib-pits are all small. In the specimen figured by Dr. Case (Univ. Geol. Surv. Kans., IV, 1898) the eighth costal comes down to a thin edge and there appears to have been no rib-end. Moreover, Case states that the eleventh peripheral has no groove nor pit for a rib. At my request Dr. C. E. McClung, of the University of Kansas, examined this specimen. He finds the pygal and the eleventh peripheral in their natural positions and the eighth costal with a sharp border and no trace of a rib. Case is probably in error in representing the rib of the seventh costal plate as going to the tenth peripheral.

Peripherals.	Length.	Width upper face.	Thickness.
1	25	11	..
2	26	11	..
3	30	8	12
4	33	15	15
5	36	12.5	15
6	38	15	10
7	36	15	8
8	32	16	5
9	33	15	5.5
10	32	16	7.5

The plastron appears to have resembled quite as much that of the Cheloniidæ as it did that of *Chelydra*. As in the former family, that part of the plastron which lay between the fore and

hind legs was much broader than it is in the case of *Chelydra;* and, as in the sea-turtles, there was a fontanel between the outer end of the hyoplastron and hypoplastron. There was also an extensive umbilical fontanel. The bones of the right and left sides were joined along the midline more like those of *Chelydra* than like those of the Cheloniidæ. The epiplastron and entoplastron are figured by Wieland (Amer. Jour. Sci., xx, p. 336, figs. 7, 8). The former are slender, the latter broad and lance-shaped. The xiphiplastron, as represented by that of *T. stenopora* (Case, op. cit., plate lxxx., fig. 5), is slender and apposes digitations to its fellow.

Cervical vertebræ have been figured by Dr. Case (op. cit., plate lxxxiii, figs. 2–4). These were more or less injured, being comprest laterally. A more complete series is in the Marsh collection at Yale, and these have been described by Dr. Wieland (Amer. Jour. Sci., xiv, 1902, p. 102). According to this author, the anterior 5 have their articular ends fashioned as in *Chelydra* and the great majority of turtles; that is, the first is composed of 4 bones; the centra of the second and third are convex in front and concave behind; that of the fourth is convex at both ends, as in turtles generally. The next four centra are concave at the anterior ends, convex at the posterior. *Toxochelys* differs from modern Cheloniidæ in not having the double concavities developt on the anterior end of the last cervical. The specimen furnishing these cervicals was not accompanied by the carapace, so that we can not estimate the length of

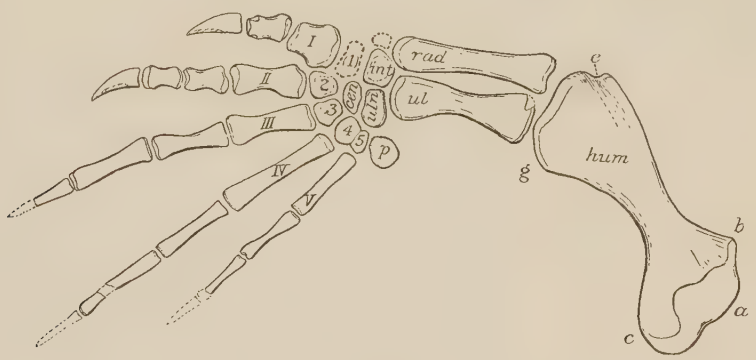


Fig. 200.—*Toxochelys latiremis.* Front limb. ×.28. Specimen in Yale Univ. coll.

a, head of humerus; *b,* radial process; *c,* ulnar process; *cen,* centrale; *e,* ectepicondylar groove; *g,* entocondyle; *hum,* humerus; *int,* intermedium; *p,* pisiforme; *rad,* radius; *ul,* ulna; *uln,* ulnare; I, II, etc., metacarpals; 1, 2, 3, etc., distal carpal bones. Figure by Wieland.

the neck relatively to the shell. The estimated length of the neck is 226 mm. The skull was 114 mm. to the occipital condyle.

Regarding the caudal vertebræ little that is certain is known. It is not at all improbable that the vertebræ which were described by Cope under the name *Cynocercus incisus* belong to *Toxochelys.* Two caudals are in a small collection of bones received from the University of Chicago, with the catalog number 230 and belonging to *Toxochelys latiremis.* The centrum of one is 18 mm. long. These vertebræ probably belonged toward the end of the tail. They are procœlous and possess short lateral processes. In general these vertebræ resemble those of *Cynocercus,* but the cup is deeper and without sign of the perpendicular incision seen in *Cynocercus,* and the ball is more prominent.

The coraco-scapular arch is more like that of the sea-turtles than like that of the snappers. The coracoid is long, narrow, and spatulate. A considerable neck is interposed between the glenoid fossa and the base of the proscapular process.

The fore limb is best known from a specimen in the collection at Yale (fig. 200), which has been described by Dr. Wieland (Amer. Jour. Sci., xiv, 1902, p. 95, fig. 1). The humerus has also been figured by Dr. Case. Dr. Leidy also has figured the proximal end of the humerus of what is no doubt a member of this genus (Cont. Ext. Vert. Fauna West. Terrs., 1873, plate xxxvi, fig. 17). For a figure of the humerus of *T. latiremis* see fig. 200, shown above. This specimen was accompanied by the lower jaw, and its identification thus made certain.

The humerus of *Toxochelys* is regarded by Dr. Wieland as representing the form which he has called "thalassoid," especially because he believes that the radial process has descended lower on the shaft than it is in *Chelydra* and that the ulnar and radial processes have moved

nearer their respective borders of the humerus. To the present writer the principal changes which have affected the thalassic and parathalassic humeri, as represented by *Caretta* and *Dermochelys*, are to be found in the straightening of the shaft; the change of the head from a position looking upward, in the natural position of the bone, to one looking toward the median plane of the animal; the descent of the radial process, on the shaft; the transference of this process, or of a component of it, toward the radial border; and the removal of the condyles for the radius and ulna and of the ectepicondylar foramen or groove toward the ulnar border of the bone. Of all these changes none seems to have taken place in *Toxochelys*, except a slight descent of the radial process. In every other respect the bone retains the characteristics of *Chelydra*.

In many other features the fore limb of *Toxochelys* has made approaches to the flipper of the marine turtles, as Dr. Wieland has shown. The ulna, as compared with that of *Chelydra*, has become shorter relatively to the humerus while the radius has become longer, as it has also to a greater degree in *Caretta*. The ulna has become shorter than the radius, and the third and fourth fingers have become greatly elongated; but in these respects it is far behind *Caretta*. The first and second fingers retain about the same ratio to the humerus that they have in *Chelydra*. Taken altogether, the limb may be regarded as standing between that of *Chelydra* and the sea-turtles but nearer to that of *Chelydra*. From the fact that the head of the humerus had the position that it has in the freshwater turtles and that the phalanges possest well-developt condyles we may be quite certain that the species of *Toxochelys* had no difficulty in getting about on the land.

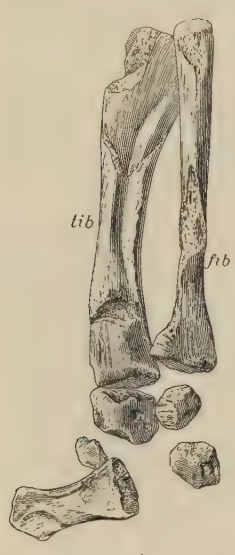


FIG. 201.—*Toxochelys sp. indet.* Tibia, fibula, and some foot bones. $\times\frac{1}{2}$.

The first and second fingers of *Toxochelys* were composed of phalanges which were much stouter than those of the other fingers. The terminal phalanges were encased in horn and formed strong curved claws. The other fingers did not probably extend beyond the border of the skin. Dr. Case (op. cit., plate lxxxii, figs. 1, 2) represents the first finger as having 3 phalanges. This figure is evidently that of the second finger.

The following measurements are taken from Dr. Wieland's description of the fore limb in Yale University Museum (fig. 200): Length of humerus, 135 mm.; radius, 75 mm.; ulna, 66 mm.; total length of the first finger, 65 mm.; of second finger, 95 mm.; of third finger, estimated, 130 mm.; of fourth finger, estimated, 135 mm.; of fifth finger, estimated, 90 mm.

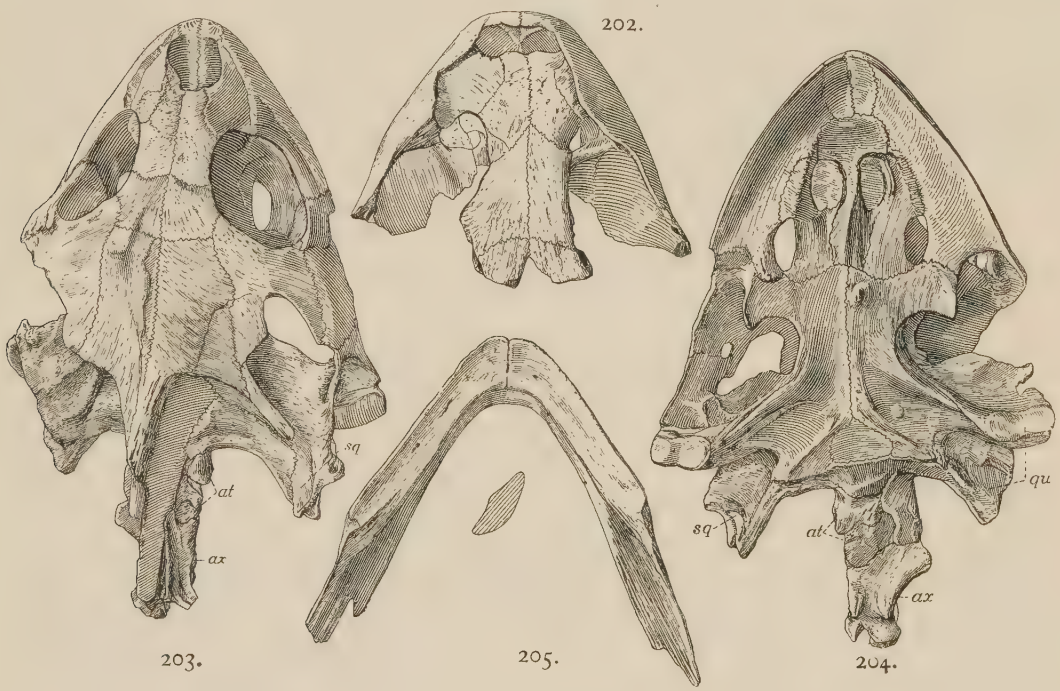
The pelvis is somewhat more like that of *Caretta* than like that of *Chelydra*. Dr. Case has given figures of the ilium (op. cit., plate lxxxi., fig. 8) and of the ischium (op. cit., pl. lxxxii, fig. 6). The antero-lateral processes of the pubis are broader than they are in *Chelydra*.

The femur is not an uncommon bone in collections of *Toxochelys* materials. Figures of the bone are presented by Case (op. cit., plate lxxxi) and Leidy (op. cit., plate xxvi, fig. 18). Unfortunately the bone is usually crusht, so that its exact form is questionable. It is certain, however, that the greater and the lesser trochanters were separated by a deep fossa, as Case has described the bone. This fossa was probably like that found in *Chelydra*. In *Caretta* and again in *Testudo* this fossa is nearly obsolete. Case believed that the femur was a weaker bone than the humerus. This view is probably correct, and is corroborated by the relative izes of the humerus and femur figured by Leidy. It is not certain, however, that these bones belonged to the same individual. In *Chelydra* the femur is the longer bone.

The tibia and fibula are not well known. There is presented in fig. 201 a portion of the hinder limb in the possession of the author and believed to belong to *Toxochelys*. The tibia and fibula are elongated and slender, more like those of *Chelydra* than like those of *Caretta*. Four tarsals are present. The metatarsal is probably that of the first toe. Case (op. cit., p. 378) describes the hind foot of an incomplete specimen, but the error is made of assigning four phalanges to the first digit. The digit may have been the second, including the metatarsal. The terminal claw was strong and much curved. The phalanges of the remaining digits were longer and slenderer, and the terminal one did not support a claw.

KEY TO SPECIES OF TOXOCHELYS.

A. Species based on skull.
  a. Symphysis of lower jaw short, about one-fifth of length of lower crushing-surface of jaw.
    b. Snout rather pointed.
      c. Jaws slender and weak; symphysis thin, sloping on upper surface..... *latiremis*
      cc. Jaw rather heavy; the upper surface of the symphysis horizontal ..... *serrifer*
    bb. Snout broad and rounded ..... *brachyrhina*
  aa. Symphysis long, at least one-third the length of the crushing-surface.
      d. Nasal opening narrow; upper surface of the symphysis sloping..... *stenopora*
      dd. Nasal opening normal; symphysis flat above.
        e. Skull as broad as long..... *elkader*
        ee. Skull longer than broad..... *procax*
AA. Species based on shell only..... *bauri*



FIGS. 202–205.—*Toxochelys latiremis*. Skulls and lower jaw. ×½.

202. Upper view of front of skull. No. 1496 A. M. N. H.
203. Upper view of skull. No. 1497 A. M. N. H. *at*, atlas; *ax*, axis; *sq*, squamosal.
204. Lower view of same skull as preceding. *at*, atlas; *ax*, *axis*; *qu*, quadrate; *sq*, squamosal.
205. Dentary portion of lower jaw, with section along the symphysis. No. 1497 A. M. N. H.

Toxochelys latiremis Cope.

Figs. 200, 202–206.

Toxochelys latiremis, COPE, Proc. Acad. Nat. Sci. Phila. 1873, p. 10; Vert. Cret. Form. West, 1875, pp. 98, 260, pl. viii, figs. 1, 2; Proc. Amer. Philos. Soc., XVII, 1877, p. 176.—HAY, Pubs. Field Columb. Mus., Zool., I, 1896, p. 101, pls. XIV, XV; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442; Bull. Amer. Mus. Nat. Hist., XXI, 1905, p. 177.—CASE, Univ. Kansas Geol. Surv., IV, 1898, p. 371, plate lxxix; plate lxxx, figs. 1, 2; ?plate lxxxi, figs. 1–8, 10–13; ?plate lxxxii, figs. 1, 2; plate lxxxiii, figs. 2–4.—WAGNER, Kansas Univ. Quarterly, VII, A, 1898, p. 201, fig. 1.—WIELAND, Amer. Jour. Sci. (4), XIV, 1902, p. 95, figs. 1, 2.

Cynocercus incisus, LEIDY, Cont. Ext. Vert. Fauna West. Terrs., 1873, p. 279, plate xxxvi, figs. 17–21.

The type of the present species consists of a portion of the lower jaw and a coracoid, of the Cope collection of reptiles and fishes, and is now in the American Museum of Natural History, New York, having the number 2362. The specimen was collected by Professor

B. F. Mudge, in the Niobrara deposits of Kansas, near the forks of the Smoky Hill River. The animal was a large one, since the mandible, from the symphysis to the angle of the jaw, measures 157 mm. In 1877, as cited in the synonymy, Professor Cope came into possession of 2 nearly complete skulls, which he identified as belonging to *T. latiremis*, and these he described. These skulls are now in the American Museum and bear respectively the numbers 1496 (fig. 202) and 1497 (figs. 203, 204). The latter (and probably both specimens) was collected somewhere along the Smoky Hill River. A comparison of the lower jaws of these skulls with that of the type makes it certain that the former were correctly referred.

The first publisht figure of the skull of this species was made by Hay, as cited. This skull lackt the lower jaw; but a comparison with the skulls described by Cope reveals no differences. Other skulls have been figured by Case and Williston, as cited.

This appears to have been the commonest turtle in the Niobrara beds of Kansas, yet many parts of its skeleton remain unknown. The size attained was considerable. If the length of the coracoid bore the same relation to the length of the carapace that subsists between these bones in *Chelydra* or *Caretta*, the carapace must have been about a meter in length. It may be remarkt here that the coracoid of Cope's type was 225 mm. long, that author's statement that it was 250 mm. being incorrect. The ramus of the mandible has a length of 157 mm., so that the skull, from the tip of the snout to the occipital condyle, was close to 160 mm.

FIG. 206.—*Toxochelys latiremis*. Scapula and coracoid. ×½. Redrawn from figures by Case.

The skull of this species is broad posteriorly. In front of the quadrates the width is gradually reduced, so that the head is wedge-shaped and the snout pointed. Altho all the skulls yet found are considerably flattened by pressure, it is quite certain that the head was rather deprest, more like that of *Chelydra* than like that of any of the living Cheloniidæ. The supraoccipital is long. The temporal region is rooft over about as in *Caretta*, and the squamosal appears to have come into narrow contact with the parietal. The orbits lookt upward and outward, resembling more those of *Chelydra* than those of the Cheloniidæ. The opening of the anterior nares is large, contrasting strongly with that of *T. stenopora*. The tympanic cavity did not extend into the squamosal, but had the stage of development seen in the loggerhead. The cutting-edge of the maxilla is moderately high anteriorly, but becomes very low at the hinder end. As seen in profile, it is convex. There is a rough ridge on the palatine near its articulation with the maxilla. The alveolar, or masticatory, surface of the upper jaw is somewhat concave from side to side. Including the ridge on the palatine, this surface is not so wide as is the fossa containing the choanæ. There are large posterior palatine foramina. The narrowest portion of the palate, across the pterygoids, is rather wide compared with the other species, and is flat. More posteriorly each pterygoid bears a groove which is directed outward and backward toward the hinder border of the quadrate.

The lower jaw is relatively weak. The alveolar surface is narrower than in the other species in which it has been observed. Fig. 205 represents the lower jaw belonging to specimen shown in figures 203 and 204. The outer edge is sharp and rises somewhat above the inner edge. The latter rounds off into the inner face of the jaw, which face is in no way hidden by the surface referred to. At the symphysis the alveolar surface extends backward little more than one-half as far as does the lower face of the bone. The tip of the jaw is slightly beakt.

Notwithstanding the fact that a considerable number of skulls of this species have come to light, portions of the carapace or plastron are rare. Wieland (as cited) mentions portions of the carapace and plastron in Yale University, but he does not describe them.

The cervical vertebræ and some caudals have already been described in the discussion of the genus. No other vertebræ are known.

For description of the shoulder-girdle (fig. 206, from Case) and remarks thereon, see page 166. The structure of the anterior limb has also been described and illustrated.

No pelvis definitely known to belong to this species has been described. References to femora supposed to belong to this species have already been given, but these may have belonged to other species, as *T. procax* or *T. brachyrhina*. Case (op. cit., p. 378) describes a hind foot which he refers to *T. latiremis*. This has already been mentioned on page 167.

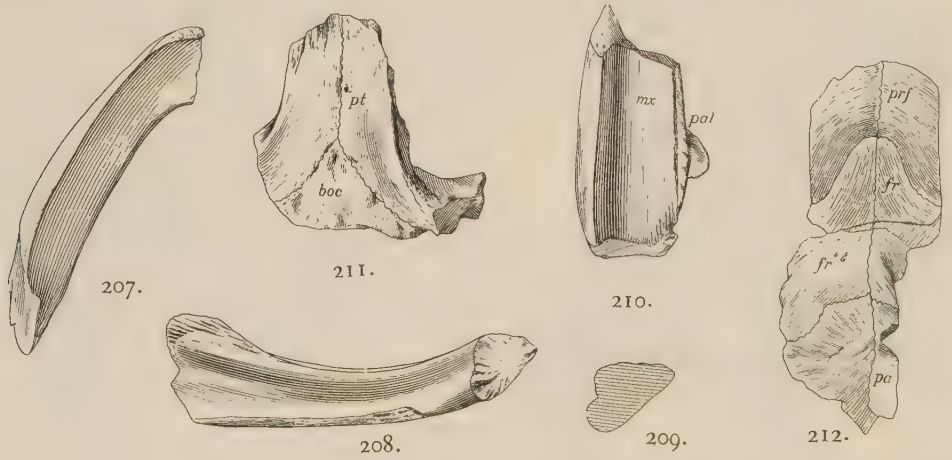
Wagner has described and figured a portion of a skull of a turtle from the Pierre shales of Kansas, which he identifies as *T. latiremis*. The present writer has not seen this skull. The lower jaw figured by Wagner certainly does not belong to *T. latiremis*.

Toxochelys serrifer Cope.

Figs. 207–213.

Toxochelys serrifer, Cope, Vert. Cret. Form. West, 1875, p. 299.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442; Bull. Amer. Mus. Nat. Hist. xxi, 1905, p. 178, figs. 1–7.

The type of this species is No. 1835 of the Cope collection of reptiles and fishes in the American Museum of Natural History, New York. It consists of the greater portion of both maxillæ, the left dentary, the greater portion of the pterygoids, the right quadrate, the frontals



Figs. 207–212.—*Toxochelys serrifer*. Portions of skull of type. ×1.

207. Left dentary. Shows cutting-edge and grinding-surface.
208. View of inner face of dentary.
209. Symphysis of lower jaw.
210. Cutting-edge and grinding-surface of upper jaw. *mx*, maxilla; *pal*, portion of palatine.
211. Base of skull. *boc*, basioccipital; *pt*, pterygoid.
212. Upper aspect of skull. *fr*, frontals; *pa*, parietal; *prf*, prefrontal.

and prefrontals, and two peripherals. They were collected somewhere in the Niobrara deposits of Kansas by Professor Merrill, in 1865.

The dentary (figs. 207-209) had not yet become co-ossified with its fellow. Its length is, as Cope states, 48 mm.; its width above, 9 mm.; the depth of the inner face, 7 mm. Longitudinally the alveolar surface is more strongly concave than in *T. latiremis*. Near the symphysis the surface is considerably concave transversely, but posteriorly it is nearly flat. The inner border of this surface is nearly on the same level as the outer. At the symphysis (fig. 209) the alveolar surface extends nearly as far backward as does the lower face of the bone. The inner face of the dentary is occupied by a broad groove. The length of the alveolar surface of the symphysis is 9 mm.

Slightly more than the posterior half of each maxilla (fig. 210) is present. The alveolar surface is flat, and the cutting-edge retains its height to its hinder end. In *T. latiremis* the height becomes reduced posteriorly. The pterygoids (fig. 211, *pt*) present no peculiarity. Where narrowest the portion of the palate formed by the pterygoids is 15 mm. wide. The quadrate does not differ from that of *T. latiremis*, except that the articular surface for the

lower jaw is much smaller. This surface is triangular, the inner lobe seen in *T. latiremis* being greatly reduced in *T. serrifer*.

The interorbital space (fig. 212) had a width of 16 mm. where narrowest. The groove on the under surface of the frontals for the olfactory nerve is relatively narrower than in *T. latiremis*, in which the groove is nearly one-third as wide as the interorbital space; whereas, in *T. serrifer* it is only about one-sixth the width of that space. The anterior borders of the prefrontals are broken away, so that the width of the anterior narial passage can not be determined. It is certain, however, that the nasal cavity itself had the lateral extent that it had in *T. latiremis*.

FIG. 213—*Toxochelys serrifer*. One peripheral and part of another. ×1.

An estimate shows that the length of the skull from the snout to the occipital condyle was about 80 mm.

Two adjacent peripheral bones are present, probably the left eighth (fig. 213) and the ninth. The eighth is 40 mm. long and 32 mm. wide, the ninth 43 mm. long and 32 mm. wide. Each is notcht just behind the widest portion and here the width of the eighth is 25 mm., of the ninth 27 mm. The thickness of the inner face is nearly 7 mm., and at the hinder end of this face is a pit for a rib.

The specimens which were referred to this species by Case (Univ. Geol. Surv. Kan., IV, p. 379) are described as *T. stenopora*. From the latter species *T. serrifer* differs in having a dentary with an alveolar surface much wider in proportion to its depth, and not beakt at the tip.

It is evident that the skull (and probably the whole skeleton) of *T. serrifer* was much larger than that of *T. stenopora*. This makes it all the more remarkable that the dentary of the former is relatively so short and that the depth of *T. stenopora* is so great. It seems not improbable that the carapace and part of the plastron described by Wieland as *T. bauri* will prove to belong to the present species.

Toxochelys brachyrhina Case.

Plate 31, fig. 1.

Toxochelys brachyrhinus, CASE, Univ. Geol. Surv. Kansas, IV, 1898, p. 378, pl. lxxxiv, figs. 1, 2.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442; Bull. Amer. Mus. Nat. Hist., XXI, 1905, p. 177.

The type of this species is a skull, the property of Kansas University, and bearing the number 1212. Dr. Case's description of it is exceedingly brief. The character which he gives as distinguishing it from *T. latiremis* is the much blunter snout. Case's fig. 1 of his plate is three-fourths of the natural size; and, while the form of the skull is shown, the details are not well represented. His fig. 2 is a restoration of the size of nature, but it does not indicate the sutures; likewise it represents the anterior half of the skull as somewhat too broad.

The skull of this species appears to be distinguisht from that of *T. latiremis* in being narrower posteriorly in relation to the length and in having a broader snout. Another distinguishing character seems to be found in the narrower posterior region of the palate. In the case of a large specimen of *T. latiremis*, 130 mm. from the snout to the occipital condyle, the pterygoid portion of the palate, where narrowest, is 36 mm. wide. In the type of *T. brachyrhina*, 117 mm. to the occipital condyle, the palate is only 20 mm. wide. The interorbital space also is relatively narrower than in *T. latiremis*. In the specimen of the latter referred to, the space between the orbits is 24 mm. wide, in *T. brachyrhina*, only 19 mm.—too great a difference to be due to difference of size alone.

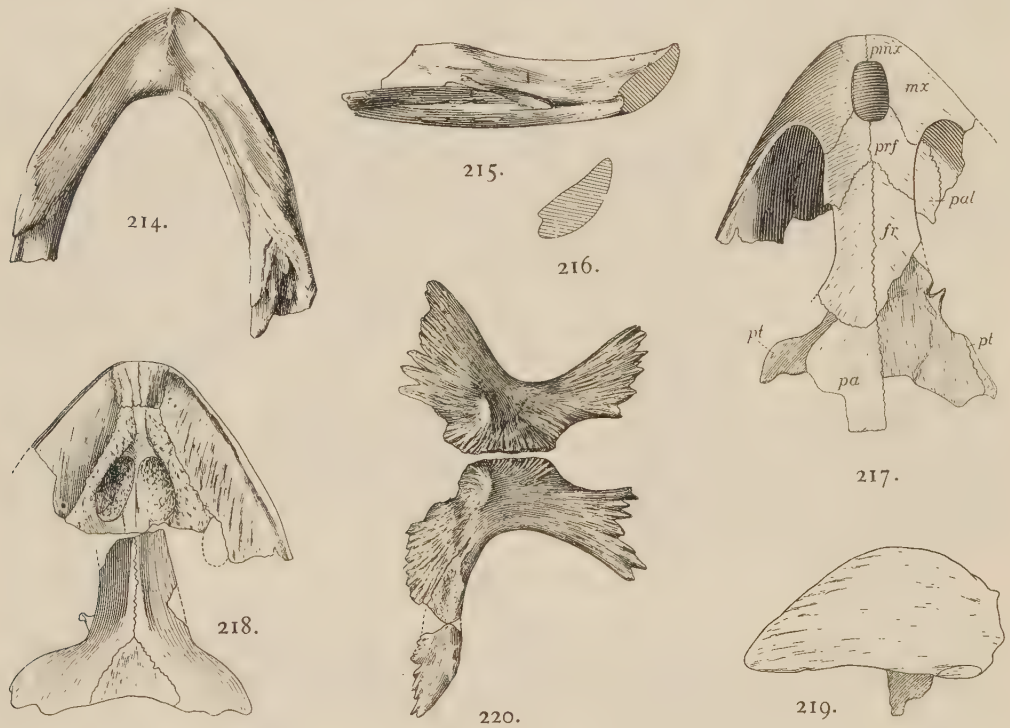
The following measurements are given of the type specimen:

	Millimeters.
Length from the snout to the occipital condyle	117
Length to extremity of supraoccipital bone	134
Distance between the outer faces of quadrates	90
Distance between outsides of squamosals	94
Width at hinder borders of orbits	80
Width at front of orbits	56

The anterior nares do not appear to have been different from those of *T. latiremis*. As seen in the type and the figures here presented, the quadrates have been squeezed forward somewhat. The lower jaw is present, but is so closely prest against the roof of the mouth that its alveolar surface can not be seen. So far as can be judged, it is not greatly different from that of *T. latiremis;* but the symphysis is evidently shorter. It is very desirable that this surface should be seen, in order to distinguish this species clearly from *T. serrifer*.

In explanation of the figure, it should be said that the inner nares are hidden by some fragments of bone, probably of the hyoids.

The type was found in the Niobrara deposits of Gove County, Kansas.



FIGS. 214–220.—*Toxochelys stenopora*. Portions of type.

214. Dentary portion of lower jaw. ×1.
215. Left dentary, showing inner face. ×1.
216. Section along symphysis of lower jaw. ×1.
217. Upper aspect of skull. ×1. *fr*, frontal; *mx*, maxilla; *pa*, parietal; *pal*, palatine; *pmx*, premaxilla; *prf*, prefrontal; *pt*, pterygoid.
218. View of palatal surface of skull. ×1.
219. Supraoccipital. ×1.
220. Left hyoplastron, hypoplastron, and xiphiplastron of type. ×½. Redrawn from figure by Case.

Toxochelys stenopora Hay.

Figs. 214–220.

Toxochelys serrifer, CASE, Univ. Geol. Surv. Kansas, IV, 1898, p. 379, plate lxxx, figs. 3–9; plate lxxxii, figs. 4, 5; plate lxxxiii, fig. 1.—HAY, Amer. Naturalist, XXXII, 1898, p. 935, figs. 1–3; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442, in part.—WILLISTON, Trans. Kansas Acad. Sci., XVII, 1901, p. 198.

Toxochelys stenoporus, HAY, Bull. Amer. Mus. Nat. Hist., XXI, 1905, p. 180, figs. 8–12.

The present writer is not able to agree with Dr. Case in his identification of the testudinate remains belonging to the University of Kansas which he has described and figured as *Toxochelys serrifer*. The type of Cope's *T. serrifer* belongs to the American Museum of Natural History and was not accessible to Dr. Case when he was studying the fossil turtles of Kansas.

Of the bones figured by Case, the skull (plate lxxxii, figs. 4, 5), the marginals (fig. 1, plate lxxxiii), and the hyoplastron (fig. 3, plate lxxx), are markt with the number 2060; while the elements furnishing fig. 4 of the last-named plate, and the neurals and suprapygal of fig. 1,

plate lxxxiii, belong to No. 1270. There appears to be no reason for doubting that these bones all belong to the same species.

The principal differences between the present species and Cope's *T. serrifer* must be sought in the form of the lower jaws and of the peripheral bones. Unfortunately we can not determine the form of the anterior nares of *T. serrifer*. The lower jaw of *T. serrifer* shows no indications of a beak, while that of *T. stenopora* (figs. 214–216) is plainly beakt. Case recognized this difference. The table herewith presents the dimensions of the two jaws.

Dimension.	*Toxochelys serrifer.*	*Toxochelys stenopora.*
Length from tip of jaw to hinder end of masticatory surface	48	33
Width of grinding surface	9	6.5
Width of inner face at middle of length	7	7
Whole depth of jaw at middle	8	9
Length of symphysis on upper surface	10	11.5

It is seen from these measurements that, although the lower jaw of *T. stenopora*, as represented by the masticatory surface, is much shorter than that of *T. serrifer*, the jaw is nevertheless deeper, the inner face of equal depth, and the symphyseal line of the masticatory surface longer. The width of the inner face of *T. stenopora* may be somewhat greater than the figures indicate, since there is evidence of some downward crushing. The symphyseal line above slopes downward and backward in *T. stenopora;* in *T. serrifer*, it is nearly horizontal.

The peripherals of *T. serrifer* are much broader and flatter in proportion to their length than in *T. stenopora*. Thus, in comparing what appear to be the eighth peripherals, we find that of *T. serrifer* measuring 49 mm. in length and 32 mm. in width, while that of *T. stenopora* is 23 mm. long and 10 mm. wide.

The bones bearing the number 2060 of Kansas University museum are made the type of the present species, and in case it should be found that the skull and the other bones of 2060 are not all of the same species, the former is to be regarded as the type.

As will be seen from the figures (figs. 217, 218), the skull has been damaged, especially the hinder portion. Nearly the whole of the roof of the temporal region is missing. The quadrates and the supraoccipital are present, but detacht from the rest of the skull. Dr. Case's figures represent the skull as larger by one-half than the originals; but this has probably been due to the failure of the engraver to reduce the original drawings.

The skull was evidently short and broad. The distance between the hinder ends of the maxillæ equaled the distance from the snout to the middle of the basisphenoid; whereas in *T. latiremis* the distance between the extremities of the maxillæ extends only to the narrowest portion of the pterygoids. The length of the skull to the hinder border of the basisphenoid is 46 mm.; to the occipital condyle was probably about 10 mm. more; while the length to the hinder end of the supraoccipital bone was about 82 mm. The palate, where narrowest, is 10 mm. wide; the interorbital space, 13 mm. The alveolar surface of the upper jaw, including the rough ridge on the palatine, is relatively broader than in *T. latiremis*, being contained in the length of the cutting-edge 3 times. In *T. latiremis* it is contained 4 times. This increase in the width of the surface appears to be at the expense of the fossa for the choanæ, which is but little wider than the surface referred to; whereas in *T. latiremis* the fossa is much wider. In the wideness of the alveolar surface and the narrowness of the fossa the present species resembles *T. procax*.

There were without doubt posterior palatine foramina, as in the other species of the genus.

That which distinguishes this species from all others of the genus, so far as known, is the narrowness of the anterior nares. This slit-like opening is evidently natural, or due only very slightly to any compression during fossilization. The skull is flattened somewhat by pressure, from which condition we may conclude that the narial opening originally had possibly a more perpendicular position than at present.

A portion of one parietal bone is among the remains of the skull. It presents a part of the roof of the temporal region. The supraoccipital (fig. 219) has a length of 35 mm. and a maximum height of 16 mm., being thus relatively long and high.

This skull is accompanied by the pygal and nearly all of the peripherals of one side. Some of these have been figured by Dr. Case (op. cit., plate lxxxiii, fig. 1). The pygal has a sharp posterior border and a rounded anterior border. From the latter there springs a process which

has joined the hindermost suprapygal. Above and below, the pygal is broadly grooved from front to back. The most anterior peripheral is thin and narrow. The second is only slightly wider. The third has its inner face more developt and possesses a pit which received the extremity of the rib of the first costal plate. The inner, or costal, face of the succeeding peripherals increases in breadth, until a section of the bone is a nearly equilateral triangle; then the face is reduced, so that at about the eighth the bone has grown quite thin and flat and relatively broad. Each peripheral, except the first and the second, has a pit for the reception of a rib-end, until we come to the tenth.

Ordinarily in turtles the eighth costal plate sends its rib to the tenth peripheral, but in *Toxochelys* the eighth costal plate is short and its rib does not extend beyond the border of the plate. As in *Chelydra* and most other turtles, there is no rib-end reaching the eleventh peripheral. In the Cheloniidæ the rib of the eighth costal plate is turned backward to this peripheral, one of the more anterior peripherals not receiving a rib. However, Wieland represents the rib of the eighth costal plate as entering a pit in the eleventh peripheral. See fig. 235 of the present work.

No. 1270 of the Kansas University museum furnishes a number of costal plates, a few neurals and the anterior suprapygal bone. These are represented in Case's figure already referred to. According to the present writer's views, another peripheral ought to be inserted between the last one of that figure and the pygal; and there was almost certainly at least one suprapygal behind the one there represented. The neural which Dr. Case has called the ninth is certainly the eighth, since it has articulated with it the eighth costal. Resting partly on this neural and the first suprapygal is a comprest tubercle at the base of which is a distinct suture. The neural seen in front of the one just referred to is probably in its correct position; but the next one in front is certainly wrongly placed, being probably the fifth. The facet on the anterior end of the upper surface of the sixth has undoubtedly supported a tubercle similar to the one resting on the eighth neural.

The midline of the carapace of *T. stenopora* was traverst by a sharp and tuberculated keel, such as has been described as occurring in the specifically undetermined species (p. 164). As in that form, the more anterior tubercles were connected with their underlying bones by open sutures. The elevation of the shell was probably about the same that we find in *Chelydra*.

In the figure presented by Dr. Case, the costal plates are probably correctly placed with reference to one another. As will be seen, there were large fontanels between the distal ends of the ribs.

The plastron is represented by fig. 220, reproduced from Dr. Case's work so often quoted. Nothing is known regarding the entoplastron and epiplastron. There was a large umbilical fontanel, while there was, on each side, another fontanel bounded by the peripherals outwardly and by the hyoplastron and hypoplastron in front and behind. The lateral digitations of the plastral bones did not enter into pits in the peripherals. The median digitations probably approacht closely those of the opposite side. A prominent longitudinal ridge on each side crost the hyoplastron and hypoplastron.

Toxochelys elkader sp. nov.

Figs. 221–223.

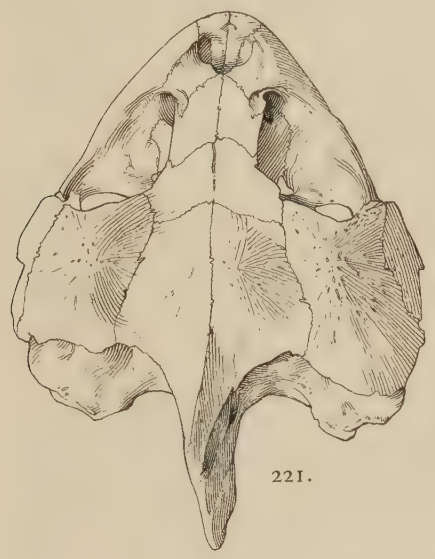
Of the type of this species, No. 6137 of the American Museum of Natural History, there were secured the skull nearly complete; large portions, perhaps the whole, of the plastron; the shoulder-girdles; portions of the pelvis; and apparently one or two peripherals. Excepting the skull, the parts have not yet been prepared for study. The specimen was found in the Niobrara beds, near Elkader, Logan County, Kansas, by Mr. H. T. Martin, of the University of Kansas.

The skull, like most specimens found in the Niobrara beds, is somewhat crusht. The length from the snout to the occipital condyle is 105 mm.; to the end of the supraoccipital spine, 143 mm. From the outside of one quadrate to that of the other is 101 mm. The outline of the skull, from a little in front of the quadrate, is nearly straight to the rather pointed snout.

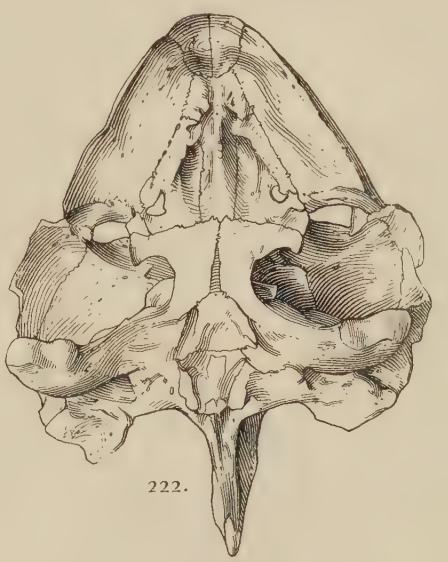
Both squamosals (fig. 221) are missing, but it is probable that each sent upward a process to the parietal. The latter bones are complete. The jugal extended nearly to the pedicel of the

quadrate. On the right side the whole of the quadratojugal is missing, but on the left most of it is present, but crusht. The interorbital space is 22 mm. wide. The orbit has an anteroposterior length of 38 mm. The nasal opening is 15 mm. wide.

The pterygoid portion of the palate (fig. 222), where narrowest, is 20 mm. wide, being narrower than in *T. latiremis*. The distance between the ends of the pterygoid processes is 46 mm.; whereas, in *T. latiremis* of the same size, the distance is 53 mm. The postpalatine foramina have a diameter of 5 mm.; those of *T. latiremis*, a diameter of 13 mm.



221.



222.

FIGS. 221 AND 222.—*Toxochelys elkader*. Skull of type. $\times\frac{1}{2}$.

221. Upper view. 222. Lower view.

The choanæ are slightly further from the snout than in *T. latiremis*, the anterior boundary being 28 mm. away. This region is constructed much as in *T. procax*, but the choanæ are relatively nearer the snout. The triturating surface of the upper jaw is 21 mm. wide, including a roughened ridge 5 mm. wide on the palatine.

The lower jaw (fig. 223) is apparently somewhat crusht downward. It is complete, except that both articulars appear to be missing. The triturating surface looks directly upward, is slightly concave transversely, and its inner border overhangs the inner face of the bone. The surface is 15 mm. wide at the middle of the length, widening forward, becoming narrower backward. The symphysis has a width of 23 mm., both above and below.

FIG. 223.—*Toxochelys elkader*. Lower jaw of type, with section at symphysis. $\times\frac{1}{2}$.

So far as is to be seen, the plastral bones do not differ from those of *T. serrifer*. One coracoid is observed. The length is 85 mm.; the width of the free end, 48 mm. The bone is therefore both shorter and wider than that of *T. latiremis*.

Some of the ways in which this species differs from *T. latiremis* have been mentioned; but the lower jaws are especially different. In *T. latiremis* the grinding-surface is narrower and it slopes downward and inward toward the inner face.

T. serrifer differs in having the grinding-surface more concave from front to back, of equal width from end to end, and the superior line of the symphysis equal to the width of the grinding-surface, and to the lower line of the symphysis.

In *T. stenopora* the triturating surface of the lower jaw slopes downward and inward to meet the inner face of the jaw. The upper line of the symphysis slopes downward and backward and is somewhat shorter than the lower line. The nasal opening is contracted. The length of the prefrontal suture is equal only to one-half

the interorbital space, whereas in *T. elkader* the same suture is equal to the whole width of the interorbital space.

T. brachyrhina is a species with a blunter snout, a narrower lower jaw, and a much shorter symphysis. The skull is narrower behind in proportion to the length.

T. procax also has a relatively narrower skull and the choanæ are placed further behind the snout.

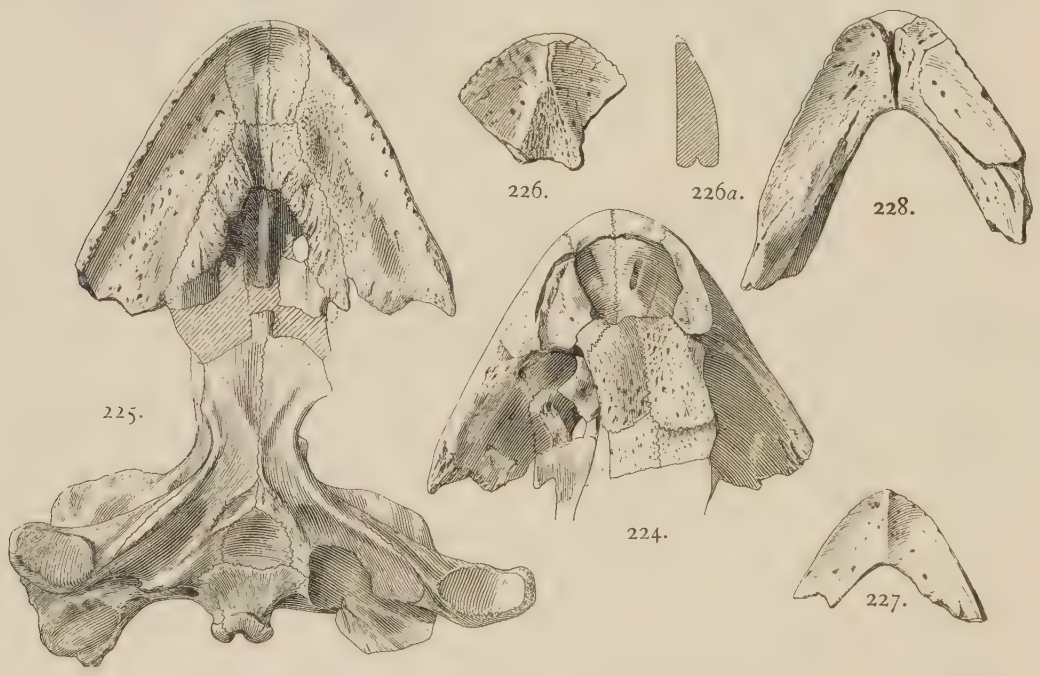
T. bauri, having been founded solely on portions of the shell, can not be compared with any species based on the skull alone.

Toxochelys procax Hay.

Figs. 224–228.

Toxochelys procax, HAY, Bull. Amer. Mus. Nat. Hist., XXI, 1905, p. 181, figs. 13, 14.

The type of the present species is a large, but somewhat damaged, skull which belongs to the American Museum of Natural History, New York. Its number is 234. It was obtained from Mr. H. T. Martin, who collected it in the Niobrara deposits along the Smoky Hill River, in Kansas, in 1901. On the lower surface, the lateral wings of the pterygoids are broken away; also the hinder extremity of one maxilla, and a small portion of the palatines. On the upper surface, the greater part of the frontals and parietals is gone, as well as the whole of the jugals,



FIGS. 224–228.—*Toxochelys procax*. Skull and lower jaw. ×½.

224. Upper aspect of anterior portion of skull of type.
225. Skull of type, showing palatal surface.
226. Tip of lower jaw, with section (226*a*) along symphysis. No. 234 A. M. N. H.
227. Tip of lower jaw. No. 220 A. M. N. H.
228. Dentary bones. No. 2050 Kansas Univ.

quadratojugals, and squamosals. On the lower jaw there are present a portion on each side of the symphysis and the hinder end of one dentary.

The form of the skull (figs. 224, 225) is like that of *T. latiremis*, except that the outlines of the maxillæ, as seen from below, are nearly straight, until the snout is approacht; whereas in T. *latiremis* the whole outline is convex. The skull is likewise more elongated than that of *T. latiremis*. The interorbital space is 27 mm. wide; and the pterygoids, where narrowest, are

22 mm. wide, taken together. In *T. latiremis*, No. 1497 of the American Museum, with skull only two-thirds as long as the type of *T. procax*, the interorbital space is 20 mm. and the pterygoids are 23 mm. *T. procax* is therefore characterized by a very narrow palate.

The most important character for differentiating this species from *T. latiremis* is found in the lower jaw. As shown by the symphyseal portions of the dentaries, the alveolar surface is very broad, horizontal, and very slightly concave. In the midline this surface extends as far backward as does the symphysis on the lower side of the jaw; whereas in *T. latiremis* the alveolar surface extends backward little more than half as far as the lower face of the bone.

From the type of Cope's *T. serrifer* this species is likewise distinguisht by the width of the symphyseal portion of the alveolar surface. In *T. serrifer* the surface extends backward nearly as far as does the lower surface of the bone; but the width above is contained in the length of the alveolar surface nearly 5 times, whereas, in *T. procax*, it is contained only 2.5 or 3 times. The inner face of the dentary is furthermore much deeper proportionally in *T. serrifer* than in *T. procax*. From *T. brachyrhina* this species differs, so far as known, in having a more pointed head and a still narrower pterygoid region. The lower jaws of the two can not yet be compared. From *T. stenopora* the present species differs in a much wider narial orifice and in the character of the lower jaw, as well as in various other respects. *T. elkader* has a relatively broader skull and choanæ not so far removed from the snout. The lower jaws of the two species appear to be greatly alike.

The length of the skull of the type of *T. procax* is 165 mm. from the tip of the snout to the occipital condyle. The distance between the outer faces of the quadrates is 138 mm. Seen from below the skull is wedge-shaped, and the snout rather pointed. The anterior narial opening is of the usual form. Little can be said regarding the upper surface of the skull.

The alveolar surface of the upper jaw (fig. 225) is broad, and a strongly developt and very rough ridge starts from the premaxilla and runs backward, first on the premaxilla, then on the palatine. Between the anterior ends of these ridges there runs a deep median groove. The palatine bones encroach more on the choanæ than they do in *T. latiremis*, so that these orifices resemble somewhat those of *Chelonia*. The alveolar surfaces are fully as broad at the anterior ends of the choanæ as they are posteriorly; whereas in *T. latiremis* they widen posteriorly. There is a deep pit in the midline on the lower surface of the premaxillæ, from which we may infer that the lower jaw bore a sharp horny beak. The cutting-edges of the maxillæ descend but little below the level of the alveolar surfaces.

The tympanic cavity appears to have had about the same degree of development that we find in *Caretta*.

At the symphysis (fig. 226) the alveolar, or masticatory surface, extends backward as far as does the lower face of the bone, and each measures 32 mm. The alveolar surface is slightly concave on each side of a low median ridge, which forks posteriorly. The symphysis has a thickness of but 12 mm., which thinness may be due slightly to compression, but this is doubtful. The groove on the inner face of the dentary continues to the symphysis. Fig. 227 represents another jaw fragment in the American Museum. Its number is 220.

No. 2050 of the Kansas University furnishes the united dentaries of this species (fig. 228), but it has belonged to a smaller specimen than the type. A small portion has been broken from the tip. The total length of one dentary is 80 mm. The width of the masticatory surface at the symphysis is 24 mm., and it extends as far backward as the symphysis does on the lower side of the jaw. The thickness of the bone at the hinder end of the symphysis is 9 mm., but in life this may have been greater. The masticatory surface is broad and flat, but narrows posteriorly. Both the inner and the outer borders are sharp, the latter overhanging the groove along the inner face of the bone. The groove just referred to passes forward to the symphysis.

The writer has been enabled to examine a skull and lower jaw of this species, which belongs to the University of Chicago. Its catalog number is 572. The exact locality in Kansas is unknown. The skull is 117 mm. long from the snout to the condyle. The upper surface is damaged to the same extent as in the type specimen. The masticatory surface of the lower jaw extends backward 60 mm. from the tip of the jaw. Anteriorly it is somewhat concave, but along the symphysis there is a rather prominent ridge. The thickness of the jaw at the hinder end of the symphysis is 10 mm.

Toxochelys bauri Wieland.

Figs. 229–230.

Toxochelys bauri, WIELAND, Amer. Jour. Sci., XX, 1905, p. 325, plate x, text-figs. 1–8.

Up to the present time no better carapace of a *Toxochelys* has been recovered than that forming the basis of Wieland's *Toxochelys bauri*. This specimen forms No. 2823 of the Yale University collection. It was found in the Niobrara deposits, near Monument Rocks, Gove County, Kansas. It furnishes all the neurals, and the nuchal; large portions of all the costals of the right side, except the fifth; the proximal ends of all the costals of the left side; all the peripherals of the right side, except the fifth to the eighth inclusive; all of those of the left side, except the first three and the seventh, ninth, and eleventh. Of the plastron there is present a considerable part of the right hyoplastron and hypoplastron. A number of Wieland's figures are here reproduced.

As to the distinctness of this species from all that have hitherto been described there may be doubts, which it is too early to remove. Of two of the described species, *T. brachyrhina* and

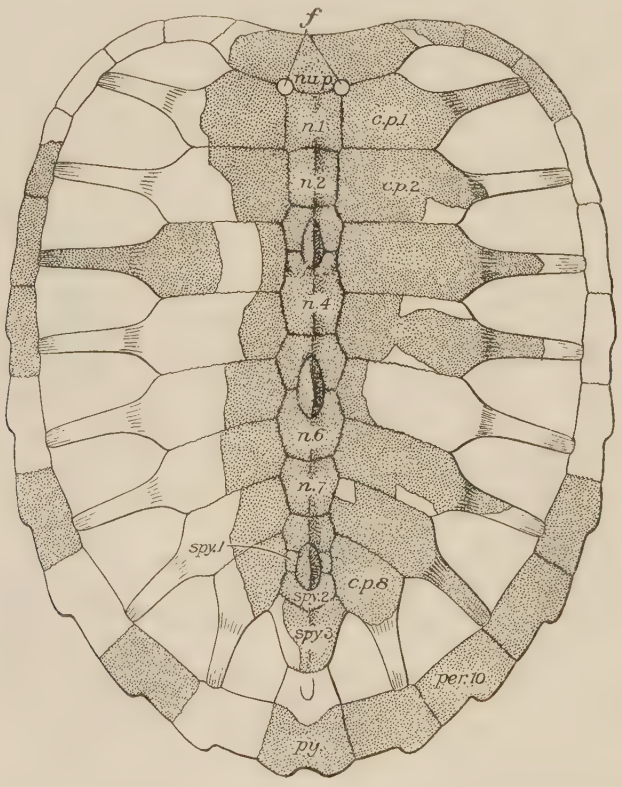


FIG. 229.—*Toxochelys bauri*. Carapace of the type. $\times \frac{1}{9}$.

c. p. 1, *c. p.* 2, *c. p.* 8, first, second and eighth costal plates; *f*, fontanels behind nuchal; *n.* 1, *n.* 2, etc., the neural bones; *nu. p*, nuchal plate; *per.* 10, the tenth peripheral; *py*, pygal bone; *spy.* 1, *spy.* 2, *spy.* 3, the suprapygal bones. Or, *spy.* 1 may be the ninth neural; *spy.* 2 and *spy.* 3, first and second suprapygals.

T. procax, no portions of the shell are known; and *T. bauri* may be the shell of one of these. Of *T. latiremis* only small portions of the shell are known; but to judge from the figures of the nuchal that have been publisht, the species is distinct from *T. bauri*. The latter appears pretty certainly to be distinct from *T. stenopora*. Of the carapace of *T. serrifer* Cope there are known only two peripherals, apparently the eighth and the ninth. These appear to resemble greatly the same peripherals of Wieland's species. They belonged to an individual about half the size of the latter. The eighth of Wieland's type had a length of 80 mm. and a width, at the notch, of 45 mm.; the ninth, a length of 75 mm. and a width of 45 mm. The eighth of *T. serrifer* is 41 mm. long and 25 mm. wide; the ninth, 43 mm. long and 27 mm. wide. It will be seen that

the latter two peripherals are slightly wider proportionally than are those of *T. bauri*. As regards the thickness no definite statements can be made about either species, but both appear to resemble the corresponding peripherals of *Lytoloma*.

The carapace of *T. bauri* has a length of about 530 mm.; its greatest width, when restored to what is regarded as its original form, is about 400 mm. The species was therefore of considerable size and the form was relatively narrow. In front the outline is concave along the nuchal; while the rear is rounded. There are no excavations over the anterior limbs, such as are seen in the modern Cheloniidæ.

This carapace is composed of 8 pairs of costals, a nuchal, 9 neurals, apparently 3 suprapygals, a pygal, and 11 pairs of peripherals. The first, second, and tenth peripherals had no connection with the costals. The others received each the extremity of a rib in a pit. In all, except the third and the eleventh, this pit is nearest the hinder end of the peripheral. There are large costo-peripheral fontanels, which extended from the peripherals half-way to the neurals. Besides these vacuities, there is a small one on each side at the common meeting-place of the nuchal, the first costal, and the first neural. Similar vacuities are found in a few of the Trionychidæ.

The accompanying table shows the dimensions of the neurals, taken from Wieland's description of the species. The forms may be determined from fig. 229.

Neural.	Length.	Width.
1	38	38
2	44	37
3	44	40
4	46	44
5	34	45
6	50	40
7	40	38
8	25	35
9	15	35

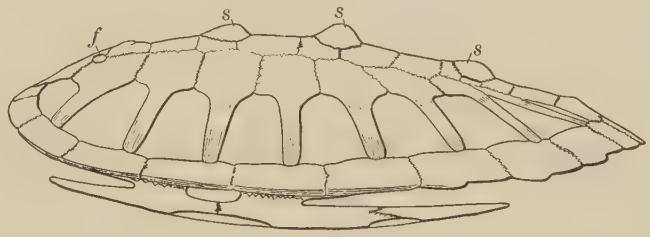


FIG. 230.—*Toxochelys bauri*. Shell presenting left side. ×1/9.

f, fontanels behind the nuchal; *s*, *s*, *s*, series of ossicles surmounting certain of the neural bones. Reproduced from figure by Wieland.

It seems evident that an extra neural was intercalated in the series. This is shown by the fact that, as the series runs, most of them are crowded somewhat out of their natural positions, being nearly as much in contact with the costals in front of them as with those to which they belong. This intercalation is shown in another way. There is a series of ossicles, 4 in number, along the midline—ossicles which Wieland calls epineurals. The first forms a slight boss on the first neural. The second lies across the suture between the third and the fourth neurals; the third, across the suture between the fifth and the sixth neurals; the fourth rests on the eighth and ninth neurals and the first suprapygal. This arrangement does not agree with that appearing to exist in the other specimens of this genus which have furnisht the neurals. Moreover, it does not correspond with the usual arrangement of the horny scutes of turtles. In the specimen described by the writer in the American Naturalist (XXXII, 1898, p. 936) and in the specimen here described on page 164, a sulcus passes behind each of the tubercles surmounting the neurals. This sulcus in each case separates two of the vertebral scutes. Now, almost without exception, the first sulcus crosses the first neural, the second crosses the third neural, the third traverses the fifth neural. The position of the fourth transverse sulcus varies somewhat, but it is usually found on the eighth neural. In the present specimen the sulci must have crost on the first, the fourth, the sixth neurals and the first suprapygal. It seems evident that it is the third neural of the series that is an intruder and disturber. In a specimen of *Colpochelys kempi*, in the American Museum of Natural History, there are all together 13 neurals. The sulci cross on the first, the fourth, the eighth, and the twelfth neurals.

Peripheral.	Length.	Width.
1	60	25
2	50	25
3	59	28
4	60	..
5	65	28
6	70	33
7	75	..
8	80	45
9	75	45
10	70	45
11	68	45

The nuchal bone has a width of 120 mm. along the free

border; a maximum width of 145 mm. Its fore-and-aft extent is 55 mm. The table gives the dimensions of the peripherals. The width is taken at the notch of each where the sulcus crost the free border.

On account of considerable crushing the thickness has not been given. We are informed by Wieland that transverse sections are approximately as in the peripherals of *Lytoloma angusta* (=*L. wielandi*).

The pygal measures 65 mm. along the free border and 45 mm. along the midline.

The reader is referred to page 165 for remarks on the connection of the rib of the eighth costal plate with the eleventh peripheral of this species.

Genus CYNOCERCUS Cope.

A genus based on caudal vertebræ and a medapodial. Caudals procœlous and provided with chevrons. The articular cup with a median perpendicular groove or incision.

Type: *Cynocercus incisus* Cope.

This little-known genus is placed in the present family because of the possibility that it is identical with *Toxochelys*.

Cynocercus incisus Cope.

Cynocercus incisus, Cope, Proc. Amer. Philos. Soc., xii, 1872, p. 308; Proc. Acad. Nat. Sci. Phila. 1872, p. 129; Fifth Ann. Report U. S. Geol. Surv. Mont., etc., 1871 (1872), p. 335; Vert. Cret. Form. West, 1875, pp. 96, 260, plate viii, figs. 3–5.—Williston, Univ. Geol. Surv. Kansas, iv, 1898, p. 368, fig. 6.—Hay, Pubs. Field Columb. Museum, Zool., i, 1896, p. 106; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442.

Cynocercus incisus was based on two caudal vertebræ and a metapodial. These were found by Cope in the yellow chalk, probably the Niobrara, near Butte Creek, south of Wallace, Kansas. These bones are now in the American Museum of Natural History and have the number 1582. It is not known whether the metapodial belongs to the fore or the hinder foot.

The vertebræ were fully described and figured by Cope as cited above. Williston reproduced a portion of the description and the figures of the vertebræ. The reader is referred to these authors. It may be here stated that the length of the centrum of each of these vertebræ is 27 mm., a fact showing that the animal must have been of considerable size. They did not belong among the most anterior, for they possest chevrons. Cope stated correctly that they differ from those of *Chelydra* in being procœlous. They differ further from those of the latter genus in being more comprest and in having higher neural arches. Cope suggested a resemblance to those of the Trionychoidea. From the latter they differ in possessing chevrons and in having the transverse processes attacht to the centrum. The vertebræ of the anterior half of the tail of soft-shelled turtles have high neural arches; from these spring transverse processes.

What appears to distinguish these caudals from those of any other known genus is the presence of a sharp groove, or incision, running perpendicularly down the middle of the articular cup. It has been suggested by more than one author that these vertebræ are those of some species of *Toxochelys;* but this has not yet been proved.

Genus PORTHOCHELYS Williston.

Skull as broad as long. Nasal bones present. Lateral fontanels of the carapace obsolete. All of the peripherals articulating closely with the costals. No carina along the middle of the back and no tubercles. Plastron with small median and lateral fontanels.

Type: *Porthochelys laticeps* Williston.

Porthochelys laticeps Williston.

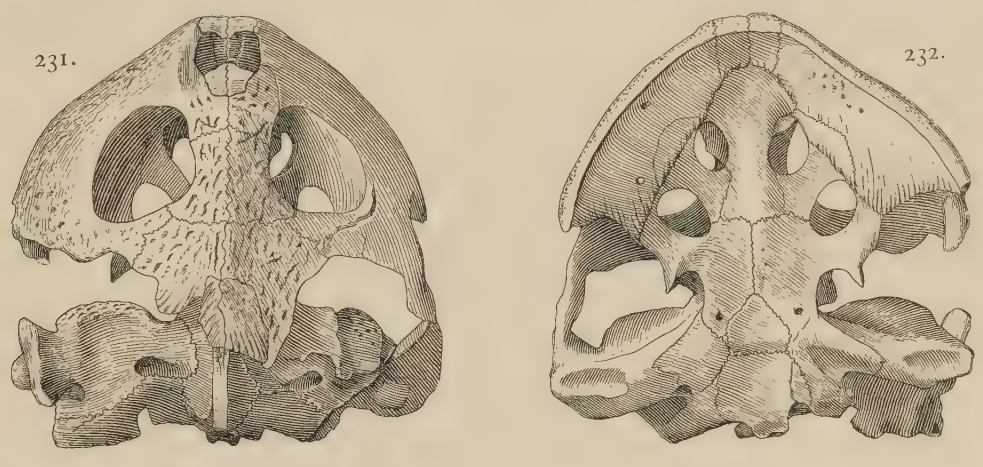
Plate 31, figs. 2, 3; text-figs. 231–234.

Porthochelys laticeps, Williston, Trans. Kansas Acad. Sci., xvii, B, 1901, p. 195, plates xviii–xxii. Hay, Bull. Amer. Mus. Nat. Hist. xxi, 1905, p. 183.

The type of this fine species is the property of Kansas University and was collected in the Niobrara beds, on the Saline River, in Trego County, Kansas. The remains comprize the greater portion of the skull, nearly the whole of the left side of the carapace, the whole of the

plastron (except the epiplastra and the entoplastron) and the right humerus. From the portion of the carapace present the whole has been restored, as seen in Professor Williston's original description. The figures presented in the present work have been redrawn, with slight modifications, from Williston's paper.

The skull (figs. 231, 232) is remarkable for its breadth and the massiveness of the jaws. As shown by the figures, the posterior breadth is maintained with slight diminution far forward, so that the head appears very blunt, altho the snout is somewhat produced. The narial opening is broader than high, and its upper boundary is furnisht mostly by a pair of small nasals. The orbits are rather large and directed rather strongly upward. The interorbital space is 19 mm. wide. The bones covering the temporal region are so much damaged that the



FIGS. 231 AND 232.—*Porthochelys laticeps*. Skull of type. $\times\frac{1}{2}$.

231. Upper surface. 232. Palatal surface.

extent of the roof can not be determined; but it was probably as extensive as in *Toxochelys*. The bones of the upper surface of the skull are much roughened, as in *Chelydra*.

The palatal surface of the skull is shown in fig. 232. The cutting-edge of the maxilla is deeper than in *Toxochelys latiremis*, and its depth increases toward the jugal bone. The palatal surface of the bone, 10 mm. wide in front, increases to 20 mm. at the hinder end. The masticatory surface extends over on the palatine and is markt internally by a rough ridge. Transversely the surface is slightly concave. The choanæ are not encroached on by plates from the vomer and palatines, as they are in the Cheloniidæ, but lie well forward in a shallow fossa. They are separated by the vomer, which is wide anteriorly, narrow between the choanæ, and develops a sharp ridge on its palatal surface. As in *Chelydra*, each pterygoid develops a strong lateral process, against which the inner surface of the dentary workt. The width of the pterygoids, where narrowest, is 30 mm. The quadrates are notcht behind for the passage of the columella, as in *Toxochelys*.

FIG. 233.—*Porthochelys laticeps*. Dentary bones of type. $\times\frac{1}{2}$. Redrawn from Williston's figure. Shows grinding-surfaces.

Of the mandibles only the united dentaries are present (fig. 233). They are very heavy and strong bones. The masticatory surface is somewhat concave both transversely and longitudinally, and is bounded internally along the anterior half by a rough ridge. At the symphysis the two ridges unite and run to the front of the jaw. This masticatory surface is, in front, only about half as wide as is the symphysis itself; but it widens backward and overhangs the inner lower border of the jaw. The coronoid process is considerably elevated.

The carapace (plate 31, fig. 2; text-fig. 234) is now very flat. How deprest it was during life it is impossible now to say; but it probably had no great elevation. It is nearly circular,

the width being 785 mm., the length only 730 mm. The border appears to have been slightly excavated in front, elsewhere somewhat repand. The costal plates are so extensively ossified that there now remain only insignificant fontanels at their outer ends. The greater portion of the nuchal bone is missing. The peripherals are eleven in number on each side. They are rather narrow in front but their width increases posteriorly, and they become quite thick. The sixth from the front is equal in width to one-eighth of the width of the carapace; the eighth is a little more than one-sixth of the width of the carapace.

Of the neurals the fifth and sixth are wholly wanting, while the fourth and seventh are represented each by only a small portion. Those present are narrow, about 30 mm. wide. The second, third, and fourth have their anterior outer angles cut off by contact with the costals in advance. The neurals are smooth, and without trace of the tubercles which are so conspicuous in *Toxochelys*. There are two suprapygals, each forming a symmetrical trapezoid, and these are placed base to base.

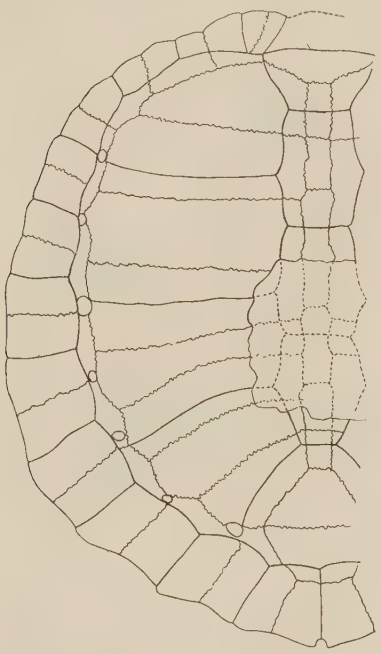


FIG. 234.—*Porthochelys laticeps*. Carapace of type. ×⅛. Restored portions indicated by dotted lines.

Dermal scutes were present, and are indicated by very distinctly markt sulci. The vertebrals are narrow, the third and fourth being about one-seventh as wide as the shell. The first is slightly wider; the fifth has a width equal to one-fourth the width of the shell. The marginal scutes lie almost wholly on the peripheral bones.

The plastron (plate 31, fig. 3) resembles greatly that of *Toxochelys*. There were small central and lateral fontanels. Probably the right and left halves of the plastron approacht each other more closely than is shown in the figure. The thickness of the hyoplastron and hypoplastron where they join is from 10 to 12 mm. They are thin and serrated along the median border.

The right humerus accompanies the remains, but the ulnar process is broken away. The bone is flattened, mostly as a result of compression during burial. It appears to have resembled closely the corresponding bone of *Toxochelys*; but the radial process has been directed more strongly toward the ulnar side. The total length of the bone was 140 mm. The position and extent of the epicondylar groove and of the condyles for the radius and ulna seem to have been the same as in *Toxochelys*. Two cervical vertebræ, a small portion of the scapula, and a claw are mentioned by Williston as furnishing no important differences when compared with those of *Toxochelys*.

In general appearance this turtle differs greatly from *Toxochelys*. The head is of heavier construction and of blunter form; there are nasals; the carapace is circular, instead of elongated and pointed behind; it is more extensively ossified; and there is no carina along the middle of the back. Otherwise *Porthochelys* agrees with *Toxochelys*. As already remarkt, the presence of nasals is regarded as being of no more than generic value.

Porthochelys browni Hay.

Figs. 235–237.

Porthochelys browni, HAY, Bull. Amer. Mus. Nat. Hist. XXI, 1905, p. 183, figs. 15, 16.

The type of this species was collected during the summer of 1903, by Mr. Barnum Brown of the American Museum of Natural History, in deposits shown by their invertebrate fossils to belong to the Pierre formation. The locality is 20 miles southeast of Edgemont, South Dakota. The catalog number of the specimen is 6080.

The specimen presents the skull and the lower jaw nearly complete, some pelvic bones, one humerus, one scapula, a femur, and some other limb bones. Unfortunately most of the bones are crusht nearly flat and were covered with a layer of gypsum. Altho the skull is considerably crusht, the most essential elements of its construction may be determined.

The skull is broad and it was probably originally considerably deprest, but to what extent the present flatness is due to pressure can not be determined. The outlines as seen from above (fig. 235) are greatly like those of *Porthochelys laticeps*, but the skull of the present species is longer than broad. The sides of the skull converge slowly to the front of the orbits, where the width is still 100 mm., then rapidly approach the tip of the snout. The outline is such that the snout appears somewhat produced. The occipital condyle is broken away, but from its estimated position to the end of the snout is 160 mm.; from the end of the supraoccipital spine to the snout, 190 mm. The breadth from the outside of one quadrate to that of the other is 142 mm. The bones of the upper surface of the skull are smooth, whereas those of *P. laticeps* are ridged and grooved. The temporal region is rooft over not quite as far backward as the hinder borders of the exoccipitals and paroccipitals, so that the latter bones are seen from above. Hence, the roof is not so extensive as in *Chelonia mydas*, but about as complete as in *Caretta*.

FIG. 235.—*Porthochelys browni*. Skull of type, upper aspect. ×½. No. 6080 A. M. N. H.

fr, frontal; *ju*, jugal; *mx*, maxilla; *pa*, parietal; *pof*, postfrontal; *prf*, prefrontal; *sq*, squamosal.

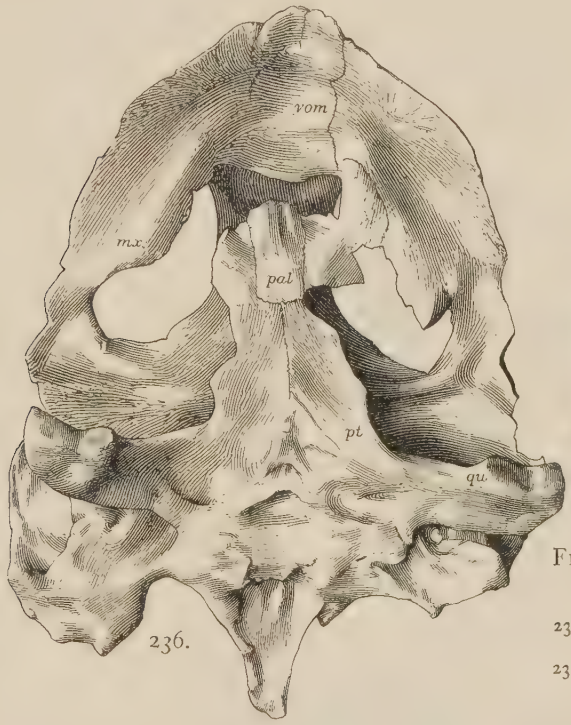
The eyes of this turtle were evidently directed strongly upward as well as outward. The distance from the middle of the lower part of the rim of one orbit to that of the other is 90 mm. The width of the interorbital space is 30 mm. If now the middle of the interorbital space stood 50 mm. above the roof of the mouth the plane of the orbits would stand at an angle of 45° with the horizontal. It is not probable that the elevation of the skull was greater than that supposed. The longitudinal diameter of the orbit is 50 mm. The transverse diameter of one is now 33 mm., of the other 30 mm. If the elevation of the skull was originally 50 mm. above the roof of the mouth the transverse diameter of the orbit must have been about 43 mm. It is not likely to have been more. Hence, we seem to be justified in believing that the eyes were directed strongly upward.

It is evident that the nasal opening was higher than wide. Its present width is 19 mm., its height 21 mm. The distance from the orbit to the hinder border of the temporal roof is 53 mm.

The anterior borders of the choanæ are placed 43 mm. behind the tip of the snout (fig. 236). The palatines appear to have joined the vomer, as in *Toxochelys*. The crushing-surfaces of the upper jaws have a width of about 27 mm. They are concave from the cutting-edge of the jaw to the palatines. The width of the combined pterygoids, where narrowest, is 39 mm.

The lower jaw (fig. 237) is nearly complete. The crushing-surface has a width of 18 mm. and is convex transversely. The cutting-edge is acute and directed outward, possibly due partly to distortion. The tip of the jaw appears to have been somewhat upturned as a beak, and there is a corresponding pit in the upper jaw just behind the premaxillæ. The symphysis has a length of 35 mm.

The humerus is crusht very flat and the ulnar process is broken off. The length of the bone, measured from the proximal surface of the head to the distal end, is 156 mm. The impression



236.

237.

FIGS. 236 AND 237.—*Porthochelys browni*. Skull and lower jaw of type. $\times\frac{1}{2}$.

236. Palatal surface. *mx*, maxilla; *pal*, palatine; *pt*, pterygoid; *qu*, quadrate; *vom*, vomer.
237. Lower jaw. *ang*, angular; *art*, articular; *dart*, dermarticular; *den*, dentary; *sur*, supraangular.

of nearly the whole head appears on the upper side of the flattened bone; hence it is evident that the head was directed upward when the bone was horizontal and not as it is in the Cheloniidæ. The radial process was connected with the head and there existed a broad excavation, or fossa, between this process and the ulnar process. In short, the humerus appears to have had practically the form of that of *Chelydra*.

The distal end of the femur is missing, but the bone was at least nearly as long as the humerus. It was, however, a slenderer bone.

The ilium resembles closely that of *Toxochelys*.

Family DESMATOCHELYIDÆ Williston.

Skull with temporal region rooft over as far backward as the occipital condyle. Large nasal bones present. Choanæ placed well forward, not underfloored by the vomer, maxillæ, and palatines. Small posterior palatine foramina present. Humerus indicating a paddle-like fore limb. Plastron loosely joined to the carapace.

The type of this family is the genus *Desmatochelys*, but the genera *Atlantochelys* and *Neptunochelys* are provisionally included. The two latter are known only from humeri. These are not greatly different from the same bones in the Cheloniidæ.

Genus DESMATOCHELYS Williston.

Desmatochelys, WILLISTON, Kansas Univ. Quart., III, 1894, p. 5.
Desmochelys, BOULENGER, Zool. Record, Reptiles, 1895, p. 29.

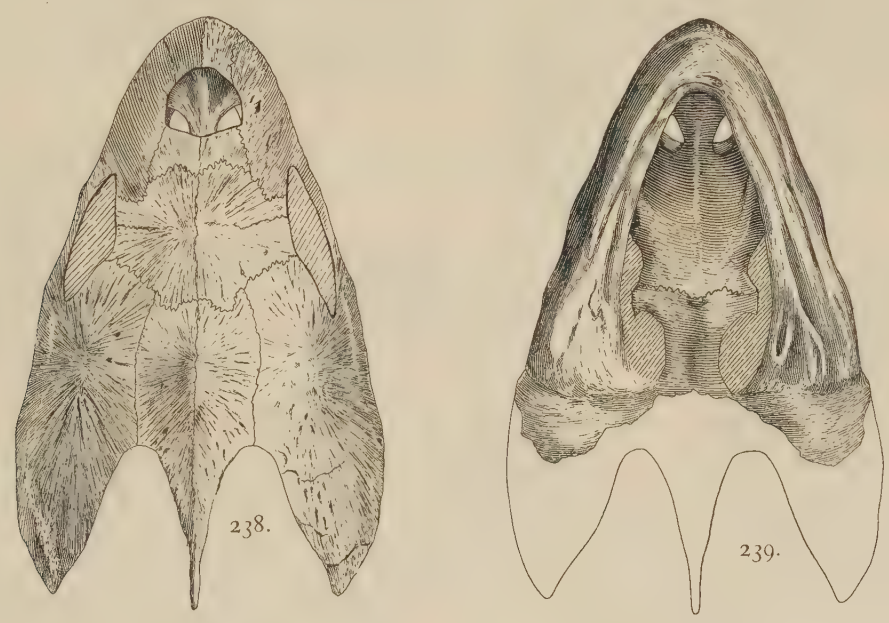
The generic characters are not yet to be distinguisht from those of the family.

The type of the genus is *Desmatochelys lowi* Williston.

This genus is a most interesting one, inasmuch as it shows evident relationships with the Cheloniidæ, and at the same time presents characters which must be regarded as more primitive than those of the latter family. Among these characters is the possession of well-developt nasal bones. The choanæ too have their primitive position just behind the premaxillæ and are separated by the body of the vomer. In the Cheloniidæ the latter bone sends downward a perpendicular plate, the lower border of which expands laterally and joins horizontal plates of the maxillæ and of the palatines, forming a floor beneath the narial passages and pushing the choanæ further backward. The possession of small posterior palatine foramina shows a closer connection with Amphichelydian stock than exists in the Cheloniidæ, which have lost these foramina.

Williston thinks that the cervical vertebræ indicate pleurodiran characters. The possession of strongly developt transverse processes is to be regarded as an inheritance rather from the Amphichelydia than from the Pleurodira. The articular ends of the cervical vertebræ show decided affinities with the Cryptodira. An intervertebral articulation which is 26 mm. wide and only 15 mm. high, belonging to a centrum only 26 mm. long, would not lend itself readily to flexure sidewise, while it would permit easy flexure in a perpendicular plane.

The Desmatochelyidæ are to be arranged close to the Cheloniidæ; but their many primitive characters demand that they be kept in a distinct family. For those who are seeking a Cretaceous ancestor for the modern sea-turtles, *Desmatochelys* presents itself as a more eligible form than any of the Cretaceous Thalassemydidæ.



FIGS. 238 AND 239.—*Desmatochelys lowi*. Skull of type. $\times\frac{1}{3}$.

238. Upper surface. 239. Seen from below.

Desmatochelys lowi Williston.

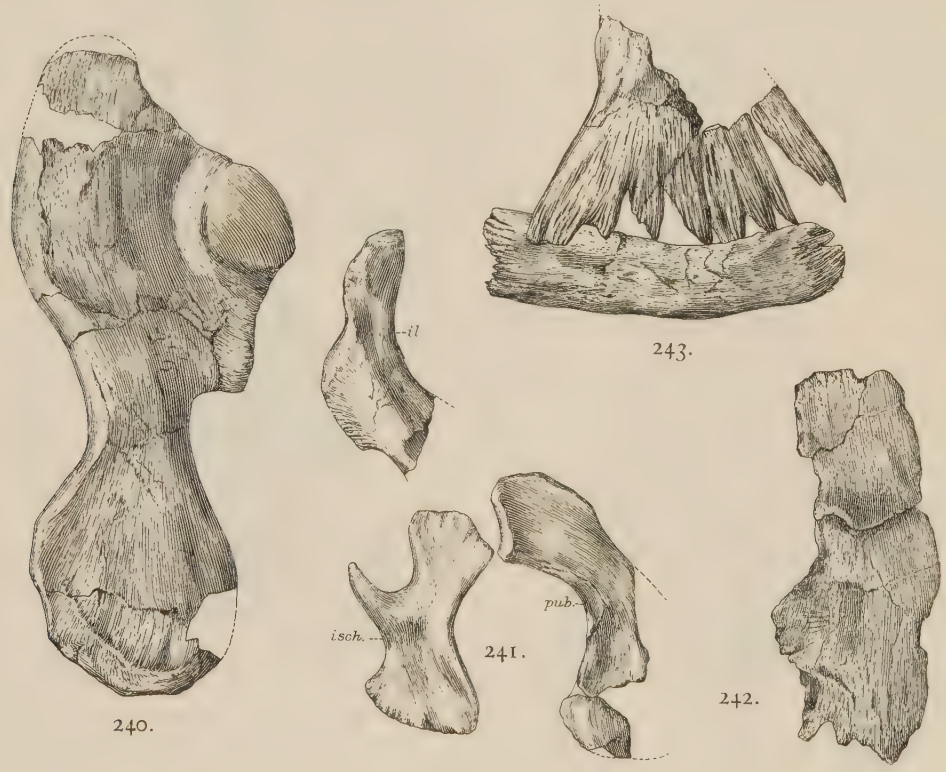
Figs. 238–243.

Desmatochelys lowii, WILLISTON, Kansas Univ. Quart., III, 1894, p. 5; Univ. of Kansas Geol. Surv., IV, 1898, p. 353, plates lxxiii–lxxviii.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 443.

The original and only known materials belonging to the present species are the property of the University of Kansas. They consist of the skull, finely preserved, but lacking the hinder part of the base; 3 cervical, the sacral, and some caudal vertebræ; the pectoral girdle, the humerus, radius, and some metacarpal bones; most of the pelvic bones and an incomplete femur; some fragments of the carapace and some of the plastron. The animal was apparently preserved in fine condition, but was damaged in collecting. The remains were found in Benton

deposits, near Fairbury, Nebraska. An extended description of the species, with figures, is given by Williston, as cited above. A number of his drawings have been reproduced in the present work.

This turtle was evidently a large one. The skull (figs. 238, 239) is uncrusht, but the hinder portion of the base is damaged. The total length from the snout to the end of the supraoccipital spine is 205 mm.; the width thru the quadrates is 145 mm. The skull is remarkable for the length of the posterior lateral, or squamosal, processes. These lack but little of extending backward as far as the supraoccipital process; while the latter has about its usual length. The parietals are unusually narrow. Williston informs us that these bones join the squamosals. The frontals and the prefrontals together occupy the area occupied in *Chelonia mydas* by the frontals. In front of the prefrontals come the large nasals, bones rarely found in Cryptodira. These nasals are about 13 mm. long and each is about 19 mm. wide. The antero-posterior



FIGS. 240–243.—*Desmatochelys lowi*. Portions of the type. $\times\frac{1}{3}$.

240. Humerus.
241. Pelvic bones. *il*, ilium; *isch*, ischium; *pub*, pubis.
242. Fragments of peripheral bones.
243. Fragments of plastron and peripheral bones.

diameter of the nasal opening is 24 mm.; the transverse diameter, 18 mm. It looks strongly upward. The orbits have an antero-posterior diameter of 60 mm. The interorbital space is 58 mm. wide.

The palate (fig. 239) is remarkable on several accounts. The choanæ are considerably further forward than they are in the Cheloniidæ; but what is more important, there is no floor beneath them formed by the bones bounding them. Each is at the anterior end of a longitudinal concavity, whose depth diminishes backward. The transverse sutures between the palatines and the pterygoids are relatively much further backward than they are in *Chelonia mydas*. The pterygoid processes are therefore more posterior than usual. The possession of posterior palatine foramina is another feature distinguishing this species from any of the modern sea-turtles. They are small, and may be regarded as vestigial. Behind the pterygoid processes the palate narrows to a width of about 22 mm. In front of the processes named there is another slight constriction of the palate. The longitudinal median sutures are not discernible, and it is not certain that the palatines joined in the midline.

The lower jaw is firmly cemented to the skull, hence no examination can be made of the triturating surfaces; they were, however, undoubtedly narrow. The symphysis is 43 mm. long.

Williston has described and figured one cervical vertebra. It is 26 mm. long, a fact indicating that the neck was short. The articular surface is 26 mm. from side to side and 15 mm. vertically. Near the hinder end of the centrum there is, on each side, a stout transverse process.

The sacral and several caudal vertebræ are preserved and have been described by Williston. The caudals are all small and procœlous.

The length of the scapula, measured from the tip to the lower border of the proscapular process, is 158 mm. The process just named is 82 mm. long. The coracoid has a length of 100 mm. and a width, at the free end, of 35 mm. The shaft is much constricted in the middle of the length.

The humerus (fig. 240) is a large flat bone, which, by its whole structure, shows that it belonged to a turtle which dared the open seas. The length, from the proximal surface of the head to the distal end, is 202 mm.; while the extreme length is 260 mm. The last dimension indicates the great height of the ulnar process. The width across the head and the ulnar process is about 110 mm. The shaft, where narrowest, has a diameter of 80 mm. The distal end is rounded and has a width of 80 mm. The radial process is large and extends downward on the shaft about 90 mm. below the upper surface of the head.

Williston figures a radius, a supposed ulna, and various bones belonging to the hand. Fig. 241, from Williston, represents the ilium, ischium, and pubis of the right side. Williston figures also an incomplete femur. Evidently it was a feebler bone than the humerus.

But little of the carapace was secured. The costal plates have a thickness of only 2 or 3 mm. The rib-heads are stout. One of the hinder costals has a width, near the proximal end, of 40 mm. The neural corresponding to it is 32 mm. wide. No sulci have been observed on any of the bones of the carapace.

Fig. 242, from Williston, represents the pygal and the adjoining right peripheral. The pygal measures antero-posteriorly at the midline, 61 mm.; and from side to side, 97 mm. Its thickness is 6 mm.

Fig. 243 represents a fragment of one of the plastral bones and one of the lateral peripherals. Evidently, the plastral bones were loosely connected with the carapace, as in the Cheloniidæ. The peripheral has a length of 130 mm., and a width of about 35 mm., and a thickness of 6 mm. Other peripherals, believed to be more anterior in position, are thicker and longer.

Not enough of the plastron was secured to furnish exact knowledge regarding its structure.

Genus NEPTUNOCHELYS Wieland.

A genus based wholly on a humerus of a turtle which was adapted for life on the sea. Humerus flattened; the head, the ulnar, and the radial processes in the plane of flattening, or nearly so. Radial process not so far removed from the head as in the Protostegidæ. Humerus resembling that of the Cheloniidæ, still more that of *Desmatochelys*, differing from the latter in having the head more nearly in the axis of the bone and the ulnar process nearly parallel with the axis.

Type: *Neptunochelys tuberosa* (Cope).

Neptunochelys tuberosa (Cope).

Fig. 244.

?Holcodus acutidens, Leidy, Smithson. Contrib. Knowl., xiv, art. vi, 1865, pp. 42, 118, plate viii, figs. 1, 2.
Protostega tuberosa, Cope, Fifth Ann. Report U. S. Geol. Surv., Montana, etc., 1871 (1872), p. 334; Vert. Cret. Form. West, 1875, p. 257.
Atlantochelys tuberosus, Leidy, Ext. Vert. Fauna West. Terrs., 1872, p. 342.
Neptunochelys tuberosa, Wieland, Amer. Jour. Sci. (4), ix, 1900, pp. 417, 418.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 440.

No part of this great sea-turtle is known except the humerus. This was found many years ago by Dr. Spillman, in Upper Cretaceous deposits, at Columbus, Mississippi. Having been found associated with the bones of a mosasauroid reptile and described before the limbs of the Mosasauria were known, it was believed to be possibly the humerus of *Holcodus acutidens*.

Cope was the first to refer the bone to the turtles, and he placed it in his genus *Protostega*. At a little later time Leidy referred it to *Atlantochelys*. In 1889 Baur correctly concluded that it could belong to neither *Protostega* nor to *Atlantochelys*, but he did not name the genus. This was reserved for Wieland to do in 1900.

The total length of the humerus (fig. 244) is 10 inches, or 253 mm. The shaft, where narrowest, is 48 mm. wide and 28 mm. thick. The distance from the extremity of the ulnar process to that of the radial process was estimated to be 152 mm. The breadth of the distal end is 93 mm.; the thickness, 30 mm. The form of the bone is shown by the figure, copied from Leidy.

Genus ATLANTOCHELYS Agassiz.

A genus based on the proximal end of a humerus of a sea-turtle. The head and the ulnar and radial processes in approximately the same plane. Radial process hardly separated from the head. Ulnar process directed nearly parallel with axis of bone. Shaft unusually slender.

Type: *Atlantochelys mortoni* Agassiz.

Fig. 244.—*Neptunochelys tuberosa*. Humerus forming the type. ×$\frac{1}{3}$.

Fig. 245.—*Atlantochelys mortoni*. Portion of humerus forming the type. ×$\frac{2}{5}$±. After Leidy.

Atlantochelys mortoni Agassiz.

Fig. 245.

Atlantochelys mortoni, Agassiz, Proc. Acad. Nat. Sci. Phila. 1849, p. 169 (no description); in Leidy, Smithson. Contrib. Knowl., xiv, art. vi, 1865, p. 43.—Leidy, Ext. Vert. Fauna West. Terrs., 1872, p. 342.—Wieland, Amer. Jour. Sci. (4), 1900, p. 419, figs. 14–16.—Hay, Amer. Naturalist, xxxii, 1898, p. 930; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 440.

Mosasaurus mitchelli, Leidy, Smithson. Contrib. Knowl., xiv, art. vi, 1865, 43, 117, plate viii, figs. 3–5.

Protostega neptunia, Cope, Fifth Ann. Report U. S. Geol. Surv. Terrs., 1871 (1872), p. 334; Proc. Amer. Philos. Soc., xii, 1872, p. 433; Vert. Cret. Form. West, 1875, p. 257.

Like *Neptunochelys tuberosa*, this species is based on a humerus which was derived from the Upper Cretaceous formation. The exact locality and level were not reported, but we know that the fossil was found in one of the beds of Cretaceous greensand in Burlington County, New Jersey.

Of this humerus (fig. 245) there was secured only the proximal half or less. This fragment had a length of about 280 mm. The shaft was extremely slender, being 73 mm. wide and 60 mm. thick. The ulnar process rises above the head about 75 mm. The radial process is

hardly separated from the head. The ulnar process is nearly parallel with the long axis of the bone. The head is farther removed from the axis than in *Neptunochelys*. In these two respects *Atlantochelys* resembles *Desmatochelys*; but it differs from the latter in having a slender shaft. This humerus must have been fully as long as that of *Archelon*, but it was of very different form. A very large turtle is indicated.

Family PROTOSTEGIDÆ Cope.

Marine turtles with the fore limbs converted into flippers resembling those of the Cheloniidæ. Carapace greatly reduced, the disk extending not one-half the distance toward the distal ends of the ribs. Peripherals present. Plastron loosely connected with the carapace and with a large median fontanel. Entoplastron T-shaped, with the lateral wings elongated and distally expanded. Epiplastra not certainly known. Xiphiplastra short and bent. Skull large, temporal region broadly rooft over. Region in front of the orbits elongated. Jaws with large crushing-surfaces. Choanæ far forward; not underfloored by the surrounding bones.

Genera: *Protostega*, *Archelon*, and probably *Protosphargis*, all of the Upper Cretaceous.

The writer is strongly of the opinion that the genera *Protostega* and *Archelon* ought to be kept apart from the modern sea-turtles as a distinct family. That both the Protostegidæ

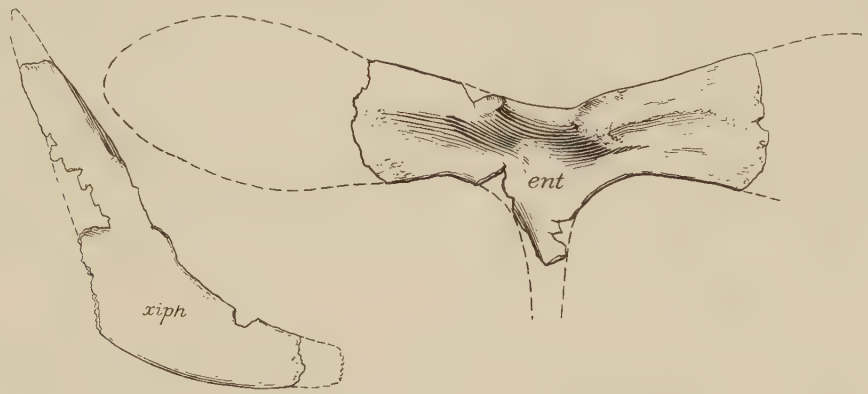


FIG. 246.—*Protostega potens*. Entoplastron and xiphiplastron of type. ×$\frac{1}{5}$.

ent, entoplastron; *xiph*, xiphiplastron.

and the Cheloniidæ had their origin from a common ancestor, which was a sea-going turtle, need not be denied; but the two branches have been separated so long, and each has developt so many peculiarities, that it seems unwise to force them into the same family. That the Cheloniidæ have been derived directly from the Protostegidæ it is impossible to believe. The latter family was in several respects more highly differentiated than the living sea-turtles. The greatly reduced carapace, the peculiar entoplastron, the abbreviated xiphiplastra, the large preorbital region, and the strongly modified humeri are examples of these differentiations.

For the discussion of the relationships of this family to the Cheloniidæ and to the Dermochelyidæ, the reader is referred to the papers of Baur, Case, Fürbringer, Van Bemmelen, Boulenger, Lydekker, Dollo, Wieland, and Hay.

The bone which is here regarded as the entoplastron (fig. 246, *ent*) was, in *Protostega*, originally described by the present writer, on the advice of Dr. Baur, as the nuchal. This view was adopted by Case and afterwards by Wieland.* The latter, in describing *Archelon*, originally held the bone to be the coalesct epiplastra and entoplastron, called by him the paraplastron. A re-examination of the subject, in the light of all the known materials, has led the present writer to change his opinion. The reasons for regarding this bone as the entoplastron are the following:

(1) The bone has never been found in direct connection with peripheral bones.

(2) It has been found four times closely associated with plastral bones, and in two or three of these cases it was in its apparently natural position with relation to the hyoplastra.

*Since this was sent to the press Dr. Wieland has publisht a paper (Ann. Carnegie Mus., iv, 1906, p. 8) in which he accepts the view that the bone is the entoplastron.

In the first instance it accompanied only plastral bones that were described by the writer. Then Case found it with its lateral wings resting on the hyoplastra. He supposed that it had fallen from the carapace to its position, a not unreasonable conclusion. After this Wieland informed us that he had found it twice in place, resting directly upon the anterior portions of the hyoplastra and beneath numerous other skeletal parts.

(3) Wieland described a bone as the nuchal which can hardly be anything else.

(4) In the specimen described here as *P. potens* the bone in question again occurs. On the visceral surface, near the anterior border, there is, on each side, a deep and broad groove (fig. 246) that must have received another bone. This groove reaches nearly to the midline. It is quite improbable that the first peripheral had a long process that filled this groove. On the other hand, the epiplastron might be expected to lie on the upper side of the entoplastron. The structure of this entoplastron is not far distant from that of *Chelydra*. In this genus there is a median backwardly directed process from the anterior end of which, on each side, there projects a lateral slender process. Were these lateral processes to become directed at right angles with the median process and to become broader, we would have just such an entoplastron as we have in *Protostega*. In *Chelydra*, *Chelonia*, and *Caretta* we find that the epiplastra overlap the lateral processes of the entoplastron, just as they seem to have done in *Archelon* and *Protostega*.

As regards the superposition of the T-shaped bone on the hyoplastra of *Protostega* there is this to be said. The entoplastron appears naturally to join the hyoplastra edge to edge. Often, perhaps usually, the hyoplastra push themselves slightly over the entoplastron anteriorly. It is, however, certain that the posterior spine-like prolongation falls above the hyoplastra. If the entoplastron expanded laterally without suturally joining the hyoplastra, there appears to be no reason why it should not rather pass above than below the latter bones. The epiplastra are missing in all the specimens in which the T-shaped bone accompanies plastral bones. These were, however, probably thin, light bones and could easily be removed from their natural position. Their outer ends, doubtless, were in ligamentous union with the anterior borders of the hyoplastra.

In Wieland's paper just referred to he describes a bone of *Archelon* which he regards as the left epiplastron. He holds that this bone was overlapt by the outer end of the T-shaped entoplastron, that certain grooves in the bone were filled by digitations or ridges of the entoplastron, and that the thickened anterior end of the bone projected outward and forward as in the trionychids. The present writer finds it impossible to place the bone in this position. It seems more probable that the bone is the right epiplastron, that the thinner end narrowed to a point and was directed inward on the upper surface of the wing of the entoplastron, while the thickened end was directed backward along the border of the hyoplastron.

Genus PROTOSTEGA Cope.

Premaxillary beak less developt than in *Archelon*. Maxilla with a rather broad grinding-surface, which extends backward to behind front of orbit. Lower jaw with the rami early co-ossified. Entoplastron T-shaped, with the middle third of the anterior border concave from side to side, the distal ends convex. Radial process of humerus large.

Type: *Protostega gigas* Cope.

Protostega gigas Cope.

Figs. 247–253.

Protostega gigas, Cope, Proc. Amer. Philos. Soc., xii, 1871, pp. 175, 452; Fifth Ann. Report U.S. Geol. Surv. Montana, etc., 1871 (1872), pp. 323, 335; Vert. Cret. Form. West, 1875, pp. 48, 102, 256, plate ix, figs. 1–7; plates x–xiii; Amer. Naturalist, xii, 1878, p. 137.—Hay, Pubs. Field Columb. Mus., Zool., i, 1895, p. 57, plate iv, v; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 440.—Case, Jour. Morphology, xiv, 1897, p. 21, plates v–vi.—Wieland, Amer. Jour. Sci. (4), ix, 1900, pp. 416, 420, figs. 8, 19; Mem. Carnegie Mus., ii, 1906, p. 279, plates xxxi–xxxiii, text-fig. 1.—Williston, Amer. Jour. Sci. (4), xiii, 1902, p. 276, fig. 1.—Osborn, Science, xix, 1904, p. 35.—Sternberg, Trans. Kansas Acad. Sci., xix, 1905, p. 123.

Atlantochelys gigas, Dana, Manual Geol., ed. ii, 1875, p. 466.

The specimen of this species which Cope originally described was found by him in 1871, in Niobrara deposits, near Butte Creek, south of Wallace, Kansas. This is now in the American Museum of Natural History and has the number 1503. At the time of its discovery the bones were much distorted and comprest; and most of them were much fractured in collecting them. Cope states that the portions described by him were reconstructed out of over 800 pieces. One of the large bony plates, described as overlying the ribs, had been broken into 108 pieces. Most of the bones are yet in the condition in which Cope left them; the large plates are, to a great extent, again broken up.

As stated by Cope, the remains preserved include many parts of the skull; 5 vertebræ, more or less incomplete; the scapular arches of both sides, with the coracoids; both humeri perfect, and some phalanges; 10 ribs; 1 doubtful neural bone; 10 peripherals; parts of 4 large plates, described as overlying the ribs; and some undetermined bones.

From his study of his materials Cope arrived at the conclusion that *Protostega* was a large marine-turtle closely allied to *Dermochelys*, and had a total length of about 12 feet.

The first author who added to the knowledge of the species was Dr. George Baur, who (Zool. Anzeiger, IX, 1886, p. 688), regarding the genus as *Atlantochelys*, stated that the plates assigned by Cope to the dorsal region were really portions of the plastron. This determination was undoubtedly made from the bones collected by Cope. Hay, as cited, gave, in 1897, a

FIG. 247.—*Protostega gigas*. Skull of type. ×¼.

Cope's determinations of the bones within parentheses. *ju* (*pt*), jugal, Cope's pterygoid; *mx* (*por*), maxilla, called by Cope the postorbital; *prf*, prefrontal; *pof*, postfrontal; *quj* (*col*), quadratojugal, Cope's columella; *sq* (*mx*), squamosal, called by Cope maxilla.

description, with figures, of the hyoplastra and hypoplastra of a specimen that had been collected for him near Butte Creek, Kansas. Case (1897, as cited) described portions of the skull and a more complete plastron than had previously been secured, materials now in the University of Kansas; and made correction of Hay's restoration of the xiphiplastra. More recently Wieland has described excellent materials which belong to the Carnegie Museum, at Pittsburg.

Cope had considerable portions of the skull and most of these he figured. The writer has studied these bones and has found that in most cases Cope's determinations were incorrect. Baur had also examined these cranial bones and accepted Cope's determinations (Amer. Naturalist, XXIV, 1890, p. 532).

Fig. 247 represents these bones, each having its name indicated. Cope's determinations are indicated in parentheses.

The first of these elements that will be noticed is that which Cope called the postfrontal (Vert. Cret. Form. West, plate xi, figs. 3*a*, 3*b*). In his description he called this the left postfrontal; but, since the straight margin was regarded as the lower, the bone would have to be placed on the right side. In reality, the bone is the left maxilla (fig. 247, *mx*), joined to the prefrontal. The straight border is the cutting-border of the maxilla; and the crusht triturating surface is seen, in Cope's figure, pushed below this border. Evidently the cutting-

edge did not extend much below the triturating surface during life. We can not now tell how wide the triturating surface was originally. At its anterior end is seen a broad articular surface for the vomer. Cope thought that this surface was for the "zygomatic" bone. Cope did not recognize the suture between the lower and the upper portions of the mass of bone figured by him. The suture is not distinct, but the radiations on the surfaces of the bones show distinctly where the suture is located. The upper bone is the prefrontal, *prf*. On the inner side of its upper border is a broad articular surface for union partly with its fellow bone, partly with the frontal. Posteriorly the prefrontal articulated with the postfrontal, *pof*, thus excluding the frontal from the orbit. In Cope's fig. 3*a* is seen a bridge of bone joining the prefrontal with the maxilla. The upper part of this bridge is undoubtedly the descending plate of the prefrontal which joined the vomer; the lower portion of the bridge is quite certainly a portion of the palatine. The foramen between the bridge and the maxilla is the nasopalatine. Cope did not explain the presence of such a bridge of bone on the supposed postfrontal.

The bones described by Cope as the pterygoid and the columellar, and accepted as such by Baur, are the jugal, *ju*, and the quadratojugal, *quj*. Those of the right side are shown in Cope's fig. 5, plate x; those of the left side in his fig. 1, plate xi. What Cope regarded as the posterior end of the larger bone is the anterior. The more concave border formed a part of the rim of the orbit. The form of both these bones is almost exactly as in *Archelon ischyros*, as figured by Wieland. As in that species, the jugal extended backward to the quadrate. The hinder border of the quadratojugal is concave to form the anterior boundary of the tympanic cavity. It is to be noted that the conspicuous oval mark shown in Cope's fig. 1, plate xi, is nothing but a little matrix overlaid by a thin layer of bone, probably of some fish. In Cope's fig. 5, plate x, the quadratojugal is in nearly its natural position. It is there recognized as the zygomatic (quadratojugal), but it is the fellow of the bone which on the other side is determined as the pterygoid. The other bone, the jugal, has been turned end about, to agree with Cope's idea of its proper position.

Both quadrate bones are present; and that of the right side is represented in Cope's fig. 5, plate x. Both are badly crusht, but that of the right side shows the condyle less distorted. Just above the condyle, on the outside of the bone, is a scar where the quadratojugal articulated with the quadrate. On the inner border of the latter bone is another articular surface for the hinder end of the pterygoid.

Cope's fig. 2, plate xi, represents a bone which he identifies doubtfully with the anterior end of the pterygoid. It is really nearly the whole of the pterygoid, a small portion of the anterior end alone being broken away. Cope's figure represents the bone as seen from below. At the hinder end of the bone, on its upper surface, is a large rough surface for articulation with the quadrate. From this extends forward a ridge which may have joined anteriorly either the columellar bone of the lower end or the descending process of the parietal. At the hinder end and below, and represented in Cope's figure, is a rough excavation for the border of the basioccipital. The mesial half of the middle third of the lower surface is occupied by a rough surface which was overlapt by the basisphenoid. The relations here appear to have been much as in *Dermochelys*. The pterygoids are relatively narrow, outer borders thickened and obtuse.

The bone identified by Cope as the maxilla (fig. 247, *sq*) is the squamosal. Cope represents that of the left side. He regarded the curved border above the elongated process as the border of the orbit and states that the width of the bone below the orbit was 35 mm. Fortunately, the corresponding bone of the other side is present; and this shows that that curved border is the result of damage to the bone. The upper edge of the bone should extend above the lower border at least 90 mm. What Cope took to be the cutting-edge of the maxilla is the free, sharp, and smooth hinder border of the squamosal, ascending toward the parietal. What Cope regards as the premaxillary border is a free border descending to the quadrate. The wing of bone seen extending upward in Cope's figures is the horizontal plate of the squamosal which overlapt the upper end of the quadrate and the outer end of the paroccipital. Pressure has caused it to lie nearly parallel with the body of the bone. On the outer border, that opposite the long, straight border, is seen a portion of the tympanic cavity. Wieland's figure of the skull of this species shows that a process of the squamosal reaches the outer border of the parietal.

The true postfrontal bone (fig. 247, *pof*) is present, but it was not figured by Cope and appears not to have been mentioned. It has on its lower border a process which articulates

with the upper border of the jugal. The hinder end of the bone is broken away, so that the whole length can not be determined. The breadth of the bone, taken just behind the process mentioned, is 105 mm.

No other parts of the palatines appear to have been preserved than that already mentioned. No parts of the premaxillæ, nor vomer, nor parietals, nor supraoccipital appear to have been obtained with the bones above described.

Portions of the skull of this species were described by Case as cited in the synonymy. The supraoccipital is stated to resemble closely that of the Cheloniidæ, and to be quite different from that of *Dermochelys*. The basioccipital resembles that of the latter species, except that the portion belonging in the condyle is well ossified. The basisphenoid is said to resemble that of *Dermochelys*, but is not so large. Case pointed out that the hinder end of the pterygoid was, as in *Dermochelys*, separated from the exoccipital by a lateral process of the basioccipital. The imperfectly preserved palatines indicated that the choanæ were placed far forward. The vomer had no descending process to assist in underflooring the nasal passages. The quadratojugal and the squamosal were found to be as in the Cope specimen, but to the present writer it

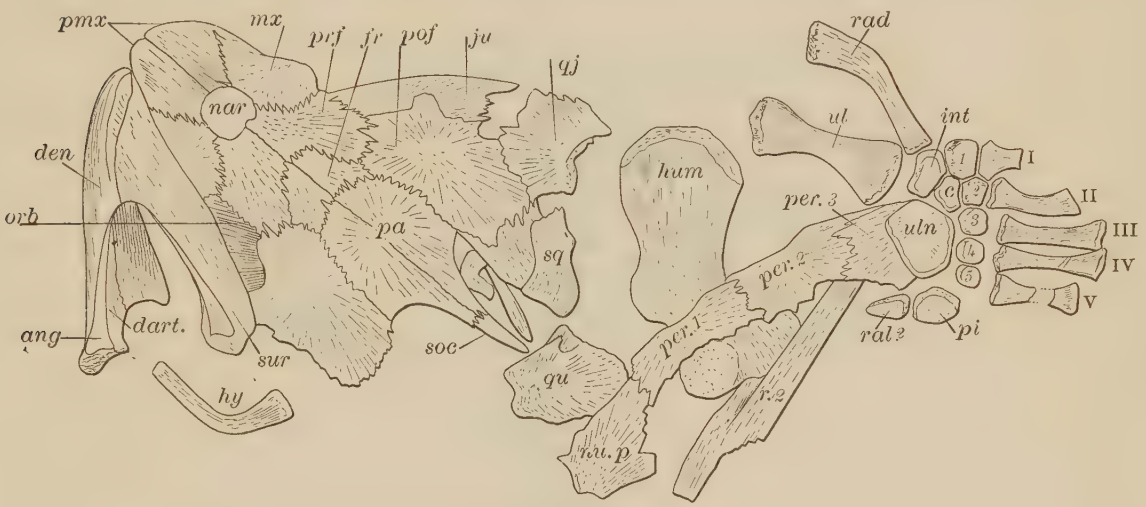


FIG. 248.—*Protostega gigas*. Skull, limb bones, and front of carapace. ×⅛. No. 1421 Carnegie Museum, Pittsburg.

Skull. *fr*, frontal; *ju*, jugal; *mx*, maxilla; *nar*, nares; *orb*, border of orbit; *pa*, parietal; *prf*, prefrontal; *pmx*, premaxilla; *pof*, postfrontal; *qu*, quadrate; *qj*, quadratojugal; *sq*, squamosal.
Lower jaw. *ang*, angular; *dart*, dermarticular, or prearticular; *den*, dentary; *hy*, hyoid; *sur*, supraangular.
Carapace. *nu. p*, part of nuchal; *per.* 1, *per.* 2, first and second peripherals; *r.* 2, second rib.
Fore limb. *c*, centrale; *hum*, humerus; *rad*, radius; *ul*, ulna; *ral?*, radiale?; *i*, intermedium; *uln*, ulnare; *pi*, pisiforme; 1–5, carpals of second row; I–V, metacarpals.

appears that Case has mistaken the upper border of the quadratojugal for the lower. The mandible was in perfect condition. The symphysis is represented as being equal to a very little more than one-third the whole length of a ramus. In addition to the bones found in the lower jaw of ordinary turtles Case states that the bone called by Baur the presplenial, by Williston the true splenial, is present.

The bones described and figured by Cope as metapodials (Cope's plate xii, figs. 3, 4) are certainly not such, but epipodials. The original of his fig. 3 appears to be a tibia. The bone on the right of his fig. 4 may be a radius. The same bone in *Archelon*, as Wieland informs the writer, is now regarded by him as the ulna.

No. 1421 of the Carnegie Museum, Pittsburg, was secured in the Niobrara Cretaceous, near Hackberry Creek, Gove County, Kansas. It furnishes the nearly complete skull; the humerus, radius, ulna, most of the carpal bones, and some phalanges of the right flipper; and the nuchal and first three right peripherals. These bones are yet imbedded in the matrix, so that only their upper surfaces are visible. The remains have been studied and described by Wieland, whose figure is here reproduced (fig. 248). The following measurements of the skull are taken from his paper:

	Millimeters.
Extreme length of ramus of lower jaw	370
Extreme length of symphysis of lower jaw	160
Length of skull from beak to end of supraoccipital spine	580
Median length of narial opening	75
Width of narial opening	55
Antero-posterior length of orbit	120

It will be observed that this skull was nearly 2 feet in length. In Wieland's figure the suture between the parietals was omitted; but this is here supplied.

It is unfortunate that only a portion of the nuchal was preserved. Its presence would have settled the question regarding the identity of the T-shaped bone, which has been regarded as the nuchal. The portion of the nuchal (fig. 248, *nu. p*) remaining with this specimen does not, the writer believes, particularly favor the opinion that it is the T-shaped bone.

No. 1393 of the Carnegie Museum was obtained at Twin Butte Creek, Logan County, Kansas. It is fragmentary, but presents various portions of the plastron, limbs, and skull.

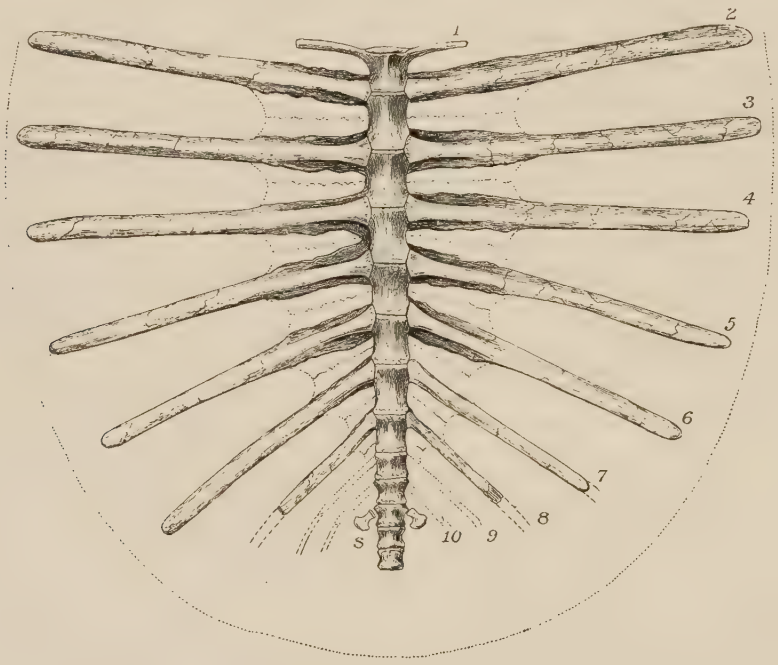


FIG. 249.—*Protostega gigas*. ×1/12. Carapace of No. 1420 Carnegie Museum.

1–10, the ribs of the carapace; *s*, sacral rib.

Some series of the peripherals show that there was a sharp free border along each side. From this a plate of bone from 50 to 70 mm. wide rose over the distal ends of the ribs. From the same border another plate, from 25 mm. to 30 mm. wide, past horizontally inward below the rib-ends. The hyoplastron and the hypoplastron taken together measure about 400 mm. in length. The greatest thickness of the hyoplastron is about 15 mm. The hypoplastron is somewhat thinner. Both xiphiplastra are present. They are of the form shown in Case's figure, but they are not so abruptly bent.

Little is known regarding the vertebræ of this species. Cope had remains of 5, but he was unable to determine where they belonged. They probably appertained to the tail. Cope supposed that the dorsal vertebræ possest transverse processes, but Wieland's figure shows this conclusion to have been erroneous. Wieland stated that a specimen at the Carnegie Museum furnisht 6 of the cervicals, but he did not describe them. Case describes 2 caudals. They were procœlous.

The carapace of this species is of great interest, and has been studied by Cope, Case, and Wieland. Cope had secured portions of 10 ribs of the type specimen. He recognized clearly

the fact that the costal plates were greatly reduced, so that the ribs were free from one another to near their proximal ends. He supposed that he had found evidences, from the great length of the costal plates from the origin of the rib-heads to the proximal border, that there were no neural bones, and that the rib-heads were attacht to transverse processes. He was undoubtedly wrong in both conclusions. Case had for examination only fragments of the ribs. He found that the neural borders of the costal plates were digitated; and from the considerable extension of these plates toward the midline from the origin of the rib-head, he concluded that there was no room for neurals. He found that the costal plates extended along the ribs for about a third of their length. Wieland had the opportunity to study a carapace, No. 1420 of the Carnegie Museum, which showed a nearly complete series of ribs. Fig. 249, reproduced from Wieland, shows this carapace as seen from below. He found the neurals to be present, but of papery thinness and much crusht down on the neural arches. Contrary to what is found in most turtles, the first rib is not turned backward against the second. It is relatively short. The other ribs are about 35 mm. wide at the middle of their length. The costal plates, forming the

FIG. 250.—*Protostega gigas*. Plastron. $\times \frac{1}{15}$. After figure by Case.

ent, entoplastron; *hyo*, hyoplastron; *hypo*, hypoplastron; *xiph*, xiphiplastron. On the left is a number of peripherals.

disk of the carapace, extend not more than one-third the length of the ribs. The total length of the ten dorsal centra was 680 mm. The distance between the distal extremities of the ribs of the fourth pair was 1060 mm.

The nuchal bone of some members of the Protostegidæ has already been discust. Cope figured a bone which he regarded as the nuchal. It is certainly a median bone, but it appears to be too small to be the nuchal, and may be the pygal. The nuchal may be supposed to resemble that of *Archelon*, as figured by Wieland (Amer. Jour. Sci., v., 1898, p. 17).

Of the peripherals Cope had 12, but the exact position of these could not be determined. They were, moreover, greatly flattened by the pressure to which they had been subjected. Some of these had only a single lamina, that rising to the ribs. Others possest, besides this, a lamina that projected toward the bones of the plastron. The end of a rib was partly buried in the lower surface of the upper lamina of each. The external border of each peripheral behind the second was acute. The upper lamina was thin and its upper border terminated in digita-

tions. We are indebted to Case for more exact knowledge of the peripherals. He had a series of 8 of these in their natural order (fig. 250). The most anterior was supposed to be the second. It is slender, concave along its free border, as if to make room for free movements of the limb, and has no pit for a rib. It is 170 mm. long and only 30 mm. wide. The third is strong, broad, and has a rib-pit. Its length is 170 mm. and its width 118 mm. The succeeding ones are longer than wide and have 2 laminæ, the uppermost of which is the broader. All these peripherals are closely joined together by means of coarse sutures.

Wieland figures (Mem. Carnegie Mus., II, p. 282) a portion of a nuchal bone and the first and second peripherals. The figure is here reproduced (fig. 248).

The hyoplastra and the hypoplastra were described by Cope as dermal bones that were supposed to overlie the ribs. Baur's suggestion that these bones belonged to the carapace has been mentioned. They had been comprest until the greatest thickness was only about 15 mm. A plastron described by the present writer showed that these bones were really thick and heavy, the thickness amounting to as much as 45 mm. in the case of the hyoplastron. The plastron described by Case (fig. 250) was somewhat larger than the one last referred to and furnisht representatives of all the elements except the epiplastra. The hyoplastra and hypoplastra are bones of an irregularly triangular form, with all the borders digitated, except over the fore and

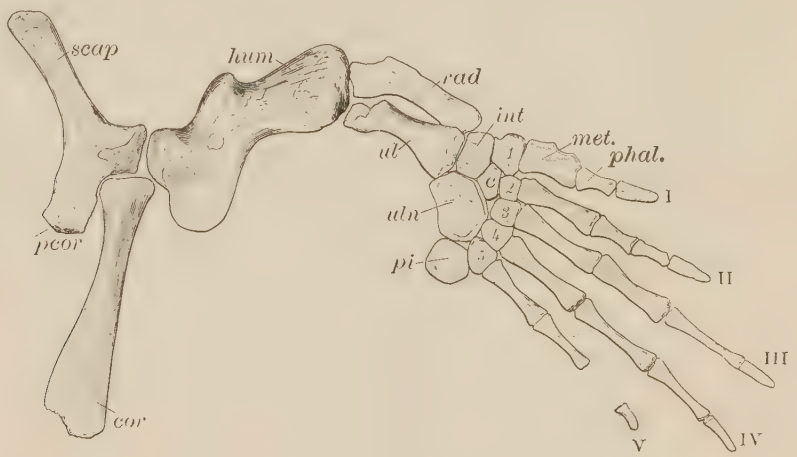


FIG. 251.—*Protostega gigas*. Right shoulder-girdle and limb; dorsal view. $\times\frac{1}{9}$.

c, centrale; *cor*, coracoid; *hum*, humerus; *int*, intermedium; I–V, the digits; *met*, metacarpals; *phal*, first row of phalanges; *pi*, pisiforme; *pcor*, procoracoid process; *rad*, radius; *ul*, ulna; *uln*, ulnare; 1–5, carpals of second row.

hinder limbs. From the anterior inner angle of the hyoplastron a thickening, appearing on the lower surface as a low ridge, runs backward thru the articulation with the hypoplastron and on backward to the xiphiplastra. From this ridge, in each direction, the thickness is reduced until the borders are reacht. Evidently there were considerable spaces left between the plastral bones and the peripherals. In the midline there was a great fontanel, which extended from the entoplastron to the xiphiplastra. The union of the plastral bones with the peripherals was a ligamentous one.

As stated, the entoplastron was first described by Hay as a nuchal. Case figured a more complete specimen as a nuchal. This was found lying with its wings overlapping the anterior ends of the hyoplastra (fig. 250). It extended from side to side a distance of 599 mm. The greatest breadth of the wings was 131 mm. From the midline of the bone there reacht backward a spine which must have attained a length equal to that of the wings. The outline of this bone was concave in front to middle of wings, then convex. The epiplastra are unknown.

The xiphiplastra are remarkable bones. Instead of extending backward and gradually inward as they do in the Cheloniidæ, just behind their articulation with the hypoplastra they turn directly inward at almost a right angle, to meet at the midline by an overlapping joint.

The limbs of this species, as of all the Protostegidæ, are modified for permanent residence on the seas.

Cope described and figured the humerus and some other limb bones. Case also added to our knowledge of the limbs; to Wieland most of all we are indebted for their complete restoration. The materials furnishing his observations are in the Carnegie Museum, at Pittsburg.

The scapula, with its procoracoid process, is a stout bone. The coracoid is so long that it reacht the pelvis. The humerus is greatly modified, resembling in some respects that of *Dermochelys*. The fingers are elongated to form a great paddle for beating the sea. The length of this limb, from the glenoid cavity to the tip of the third finger, is estimated by Wieland as being 1060 mm. The greatest spread of the fore limbs is supposed to have been 2500 mm. For details on the structure of the flippers the student is referred to Wieland's paper and to the figure here presented (fig. 251).

FIG. 252.—*Protostega gigas*. Humerus. $\times\frac{1}{3}$.

e, ectepicondylar passage.

Fig. 252, reduced from Wieland's paper, represents a humerus of *Protostega* now in Carnegie Museum. The total length is 340 mm.

Fig. 253, taken from Wieland, represents the hinder limb and the pelvis. Both the pelvis and the limb resemble closely those of the Cheloniidæ. The ilium is a stout bone. The ischium and the pubis appear to have met on the midline. The hinder limb, in comparison with the fore limb, is relatively longer than it is in most Cheloniidæ. The greatest spread of the hinder flippers is given as 1900 mm. Wieland thinks that four of the toes were clawed.

Estimates varying greatly have been made regarding the size of this sea-turtle. It is highly probable that earlier estimates made by Cope and Hay were too great. Cope concluded that his specimen had a total length of 12.83 feet, about 3900 mm. From the specimen studied by Hay about the same conclusion was reacht. The discovery by Case that the plastron was much shortened behind caused him to conclude that the total length was considerably less than had been supposed. He estimated the length, including the head, as about 2270 mm. He made the length of the carapace as 1640 mm., the width as 1235 mm. However, if we may judge from the carapace described by Wieland, the width

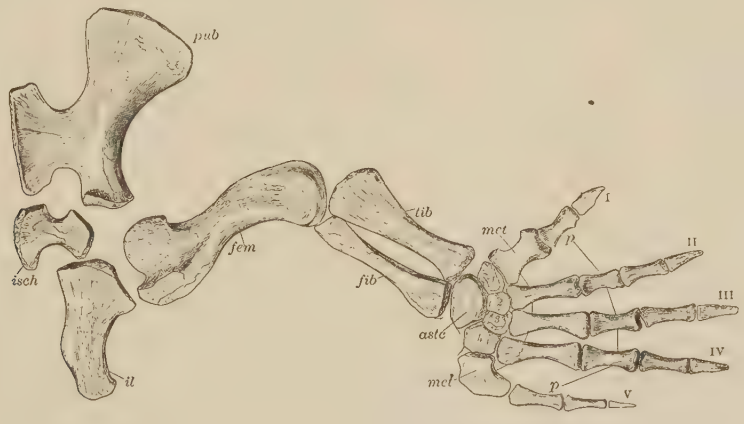


FIG. 253.—*Protostega gigas*. Pelvis and hinder limb. $\times\frac{1}{6}$.

astc, astragalo-calcaneum; *fem*, femur; *fib*, fibula; I–V, the digits; *il*, ilium; *isch*, ischium; *met*, metatarsals; *p*, first row of phalanges; *pub*, pubis; *tib*, tibia; 1-5, tarsals of second row.

was considerably greater than the length. It is now estimated that the length of the carapace of the Pittsburg specimen was about 1100 mm. and the width about 1200 mm. The total length of the animal then must have been perhaps something over 2 meters. Its humerus was 340 mm. long; that of Cope's type, 300 mm.

As regards its habits, we may safely conclude that this turtle was an active swimmer on the open seas and that it was carnivorous in its diet. Wieland is of the opinion that all the members of this group were powerfully equipt for both swimming and attack, and may well have hunted actively swimming prey. As to swimming, we must remember that the boldest swimmer among turtles of our day is the leatherback, which has an elongated body. The short, broad carapace of *Protostega* must have imparted to the animal an unsteady bearing under efforts to make rapid progress.

As regards the nature of the food, the long symphysis of the lower jaw appears to indicate a habit of crushing hard-shelled animals, such as crustaceans and mollusks.

Protostega potens sp. nov.

Figs. 246, 254, 255.

This species has as its type No. 180 of the American Museum of Natural History. This was collected by Mr. H. T. Martin, in 1897, in the Niobrara beds, near Elkader, Logan County, Kansas. The individual is represented by large portions of the skeleton, but only a part of it has been prepared for study.

There is present the hinder half of the left side of the skull. This is strongly crusht downward and toward the right side. The structure appears to be in general the same as in *P.*

FIGS. 254 AND 255.—*Protostega potens.* Basioccipital and hyoplastron of type.

254. Section across front of basioccipital. ×1. 255. Hyoplastron. ×$\frac{1}{6}$.

gigas. Sutures are not discernible, but from the striations on the bones, their limits may be pretty accurately determined. The orbit had a perpendicular diameter of 70 mm. The distance from the hinder border of the orbit to the posterior angle of the squamosal was nearly 200 mm. On lifting the anterior end of the parietal there is exposed a broad plate of bone which runs downward from the inner border of the parietal. This is without doubt the descending plate of the parietal, whose presence has hitherto been somewhat doubtful. The occipital condyle is large, having a diameter of 50 mm. The bones composing it are wholly co-ossified. Its inferior portion is eroded away. The condyle is broadly rounded behind, without trace either of a pit or of division into its constituent three bones. The lower surface of the basioccipital appears to have been greatly different from that of *P. gigas.* Case describes the latter as having its under surface nearly smooth and lying in the plane of the horizontal axis of the skull. From this we may infer that this surface is nearly flat. In the present species the midline

of the bone is traverst by a prominent ridge, the summit of which anteriorly is about 10 mm. wide and which expands posteriorly to the condyle. The sides of the ridge are formed by two bold grooves which run backward and outward from the front of the bone. Whether or not any portion of the basisphenoid is present in the fragment of bone 60 mm. long from the occipital condyle is not certain. Fig. 254 is a section taken near the front of the fragment. The summit of the ridge has been eroded off.

The carapace is represented by the midline and the ribs of the left side. It resembled that of *P. gigas*, as represented by Wieland, but the ribs are free from one another to points nearer the midline. The neurals are crusht down against the vertebræ and most of them have been subsequently eroded away. The boundaries of none can be traced. The distance from the base of the first rib to that of the tenth is close to 800 mm.; the length of the first rib is 205 mm., that of the fifth at least 655 mm. The carapace must have had a length of about 1250 mm. and a width of about 1500 mm. The ribs are free from the adjoining ones to about 120 mm. of the midline.

Large portions of the plastron are preserved, but all have not yet been made available for study. The right hypoplastron is nearly complete. Its lower surface is traverst by a low longitudinal ridge. The length of the bone along this ridge is 400 mm. The width is nearly as great. The right and left borders are furnisht with numerous digitations. At the hinder end is a notch for the reception of the xiphiplastron. Most of the process of the hypoplastron which joined the xiphiplastron on its outer border is broken away.

The xiphiplastron (fig. 246, *xiph*) is remarkably thin, being nowhere more than 10 mm. thick. It is not so abruptly turned toward the midline after being freed from the hypoplastron as is that of *P. gigas*. Its length was originally close to 375 mm. Beyond the hypoplastron both of the borders are acute; the inner is the thinner. The outer border joined, for more than the proximal half of its length, a process of the hypoplastron.

The left hyoplastron (fig. 255) is present. Unfortunately many digitations are lost, so that not all its dimensions are determinable. From the hyohypoplastral suture to the anterior end the length is 580 mm., measured on a straight line. From the just-named suture to the bottom of the axillary notch the distance is 300 mm. The entire width of the bridge was not far from 625 mm. The low ridge seen on the hypoplastron is continued forward on the hyoplastron. The suture between the hyoplastron and the hypoplastron was evidently considerably shorter than in *P. gigas*. Here the bone is about 25 mm. thick.

The T-shaped entoplastron (fig. 246) is preserved, but lacks much of the lateral wings. The lower surface is mostly convex, but on the outer end of each wing it is slightly concave in all directions. The visceral surface is concave from side to side. Near the front border, at a distance of about 25 mm. from the midline, begins a broad groove, quite deep at first, but becoming shallower on the wings. This was almost certainly occupied by the epiplastron. At the midline, near the anterior border, the bone is about 20 mm. thick. About 50 mm. from the midline, on each side, there is a rough surface, as if for a ligament. To this may have been tied the anterior end of the procoracoid process of the scapula. At the outer end of the right wing, as preserved, the thickness of the bone is only 6 mm. Here the surface which was covered by the epiplastron is 65 mm. wide.

The left scapula, without the procoracoid process, is preserved. Its length, from the upper end to the glenoid fossa, is 275 mm. The coracoid has a length of 425 mm., and a small portion of the distal end is missing. It was not expanded at the distal end. The left humerus is well preserved and not much crusht. The total length is 402 mm.; from the head to the distal end, 385 mm. From the head to the lower end of the radial process is 245 mm. The width of the distal end is 185 mm. The ectepicondylar passage is a foramen with a large opening on the articular surface.

One femur, much distorted by pressure, is present. Its length is 335 mm. The diameter of the shaft is 50 mm.

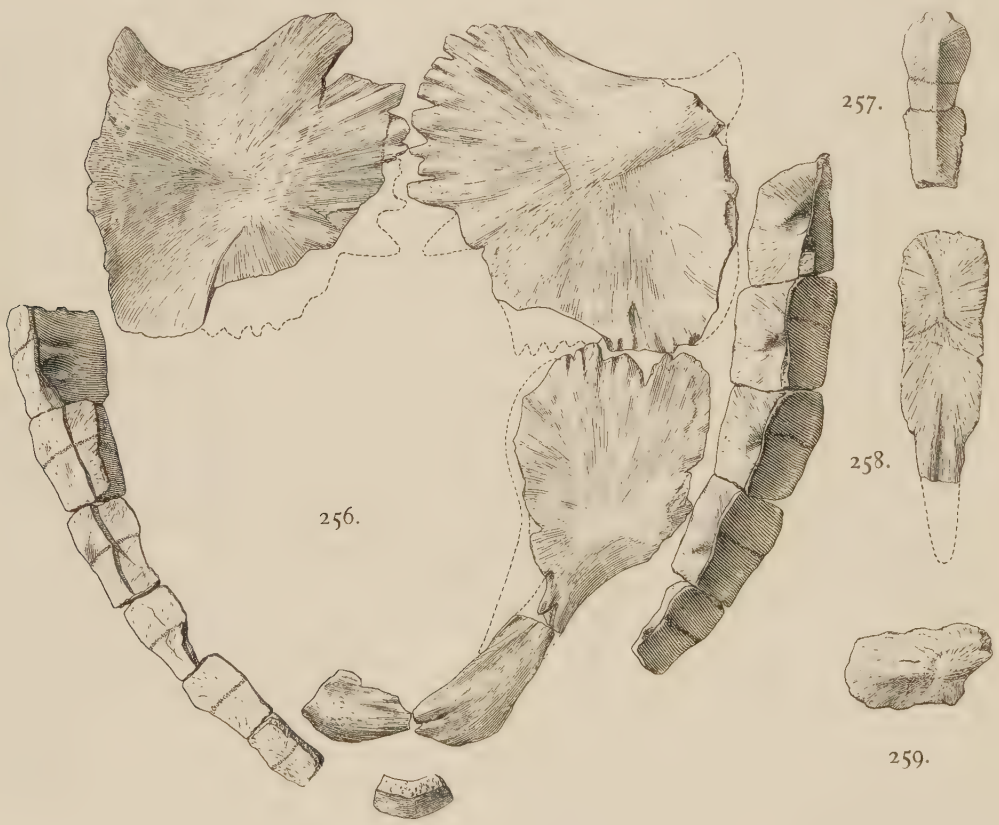
Protostega advena sp. nov.

Figs. 256–259.

The chelonian remains to which the name *Protostega advena* is given are the property of Kansas University and have the number 1209. There is no history of the time or place of

collection or of the collector. There is no doubt, however, that the specimen was obtained from the Niobrara deposits of Kansas. It consists (fig. 256) of the greater portion of the plastron, 12 peripherals, 2 or 3 neurals, and portions of 2 costal plates. With these are some other bones which are either undetermined or they doubtfully appertain to the specimen.

The hyoplastra and hypoplastra closely resemble those of *Protostega gigas*. The two of these bones which are found on the same side were apparently united for a short distance by a coarse suture. The two hyoplastra evidently came close together along the midline; but the hypoplastra were widely separated. The median fontanel has therefore extended from the hyoplastrals to the xiphiplastrals. The latter bones are not so elongated as in modern sea-turtles and *Chelydra*, nor so short and abruptly incurved as in *Protostega gigas*. The greatest thickness of the hyoplastrals is about 10 mm. The other plastral bones are thinner. There are no longitudinal carinæ on the plastron, such as we find on that of *Caretta caretta*



FIGS. 256–259.—*Protostega advena*. Portions of type. $\times\frac{1}{3}$.

256. Plastron and peripherals, seen from above. 257. Two neurals. 258. Costal bone. 259. Postfrontal.

and *Protostega gigas*. The forms and positions of the various bones may be seen from the figures. The distance from the anterior border of the hyoplastron to the hinder border of the xiphiplastron is 278 mm. The entoplastron and the epiplastra are wanting.

The anterior peripherals of both sides are absent from the materials. On the right side the most anterior peripheral present appears to be the one which has received the rib-end of the first costal plate. This is provisionally regarded as the fourth from the nuchal bone. The most anterior one on the left side is the fifth. On the left side one is believed to be missing next to the pygal; while on the right side three in front of the pygal are supposed to be gone. These peripherals prove that this individual is not a young *Protostega gigas*, since they are relatively much shorter and broader than are the corresponding bones of the latter species. They are likewise much heavier bones.

Each of the peripherals, except the posterior three, may be said to be V-shaped in transverse section, one limb of the V extending toward the edge of the plastron, the other inward and upward toward the costal plate. The upper plates are slightly concave above; the lower ones somewhat convex below. The concave and the convex surfaces of each peripheral come together to form a sharp edge, and the border of the carapace so formed runs from the fourth peripheral to near the pygal. The three posterior peripherals have no lower, or plastral, plate developt. What is regarded as the tenth peripheral has a half-pit at its hinder end. It is therefore believed that the rib-end of the eighth costal was swung backward to be inserted between the contiguous ends of the eleventh and the twelfth peripherals. In *Caretta* this rib-end has moved backward still further and is inserted in the middle of the last peripheral.

The antepenultimate peripheral has a pit for the rib-end of the seventh costal near its hinder end and this pit lies partly in the anterior end of the penultimate peripheral. If the eighth costal plate is regarded as sending its rib to the last peripheral, the next peripheral in front has no rib-end corresponding to it. In *Caretta* it is the antepenultimate peripheral which receives no rib.

The peripherals are smallest posteriorly, and they increase in size as far forward as they are represented. The fourth, the most anterior one present, has its two plates standing at an obtuse angle with each other; the fifth has them at nearly right angles, the others at less than a right angle. The plastral plate of the fifth is 37 mm. wide, the carapacial plate is 30 mm. wide. Two long narrow peripherals accompany the specimen, but they appear to be intrusive and to belong to *Toxochelys*. Two neurals (fig. 257) are present, probably the third and the fourth. The more anterior is 39 mm. long and 28 mm. wide; the other 30 mm. long and 25 mm. wide. The middle line of each rises into a low carina, which on the more anterior one rises into a tubercle. The hinder end of the anterior neural is crost by a narrow dermal sulcus, a fact which shows that dermal scutes were present. The peripherals also are crost by sulci, but these are broader than that on the neural.

The pygal is a rather peculiar bone, being nearly square, thick, convex on the hinder, or upper, surface, and with a thick free border. It is 27 mm. high, 33 mm. wide and 11 mm. thick.

With the remains described is found a detacht median dorsal tubercle exactly like those occurring in the dorsal carina of *Toxochelys*; but it is regarded as foreign to the specimen, having probably been introduced with the peripherals just mentioned.

Fig. 258 represents a costal plate of this species. It will be seen that it is less completely ossified than the costals of our modern sea-turtles, but more completely than in even a large *Protostega gigas*. In the figure the distal end is restored in outline from another costal present. Measured thru the middle of the width the costal is 7 mm. thick, but near the sutural border it becomes reduced to 3 mm. The costal figured is probably the fifth of the right side. On it are found the sulci which separated two vertebral scutes from each other and from a costal scute. These sulci are narrow and shallow. It is evident that the vertebral scutes were relatively very broad, about 110 mm., nearly equal to one-third the width of the carapace.

There are present two bones which are referred to the skull; they are the two postfrontals (fig. 259). Each is 30 mm. wide and 60 mm. long. At the hinder end the bone thins down to a sharp, nearly smooth edge; so that it becomes probable that this edge formed the hinder border of the roof of the temporal region; and hence, that the squamosal did not join the parietal. The roof was probably not so extensive as in *Caretta*.

In the Cope collection of the American Museum of Natural History is the left humerus of a small sea-turtle which was collected in Gove County, Kansas, in 1877, by one of Professor Cope's collectors. This humerus has every appearance of being that of an adult turtle. It has suffered no compression or distortion whatever. Its length, from the proximal surface of the head to the distal end of the bone, is 64 mm. The ulnar process rises slightly above the head. The radial process descends 35 mm. below the proximal surface of the head. This process is 11 mm. thick. The width of the humerus across this process is 23 mm. Just below the process the width is 16 mm. On the upper surface of the bone, opposite the radial process, is a deep muscular scar. At the distal end there is nearly a right angle between the surface for the radius and that for the ulna. The ectepicondylar passage is a shallow groove close to the radial border.

A wholly similar humerus is contained in a small collection of bones sent the writer from the University of Chicago. The few skeletal bones accompanying it are not sufficient to identify the humerus as that of *P. advena*, but it seems probable that both it and the humerus in the American Museum belong here.

Genus ARCHELON Wieland.

Premaxillary beak more strongly developt than in *Protostega*. Crushing-surface of upper jaw mostly on the premaxillaries; that on the maxillæ extending back only to opposite the choanæ. Lower jaw with the rami not co-ossified at symphysis; at least, not until old age. Entoplastron T-shaped, with the anterior border concave from end to end. Radial process of humerus feeble.

Type: *Archelon ischyros* Wieland.

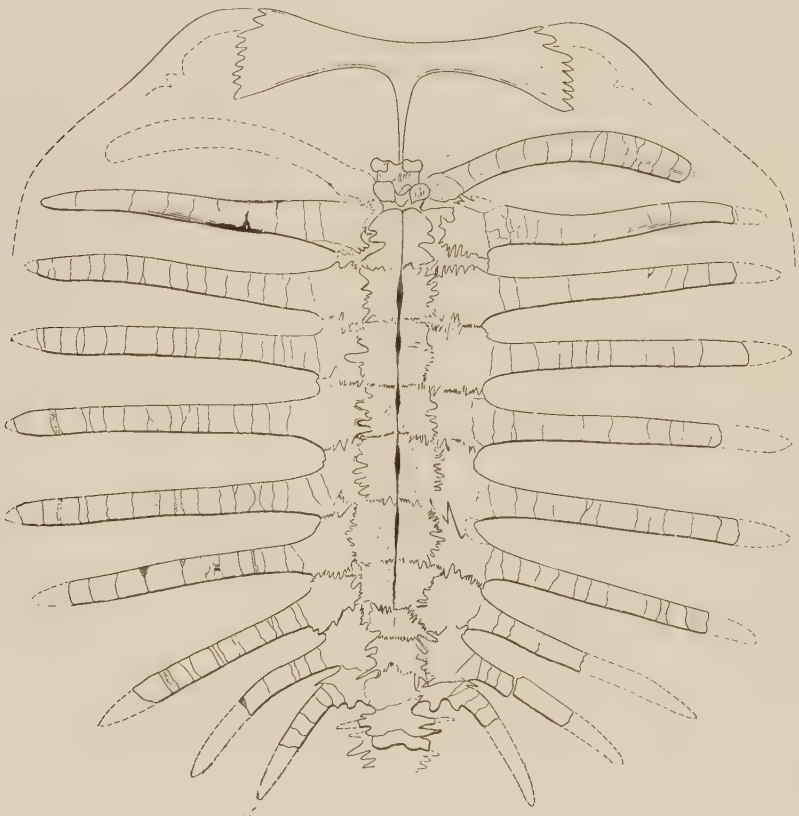


FIG. 260.—*Archelon ischyros*. Carapace with the entoplastron. $\times \frac{1}{20}$.

Archelon ischyros Wieland.

Figs. 260–268.

Archelon ischyros, WIELAND, Amer. Jour. Sci. (4), II, 1896, p. 399, plate vi, text-figs. 2–19; ibid., IX, 1900, p. 237, plate ii, text-figs. 1–3, 6; ibid., XIV, 1902, p. 99, fig. 2; ibid., XV, 1903, p. 211, fig. 1; Ann. Carnegie Mus., IV, 1906 (1907), p. 8, figs. 1, 4.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 440.

Protostega ischyros, WILLISTON, Univ. Geol. Surv. Kansas, II, 1897, p. 246.—WIELAND, Amer. Jour. Sci. (4), V, 1898, p. 15, plate ii, text-figs. 1, 2.

We owe our knowledge of this species to the study and the publications of Dr. G. R. Wieland. All the known specimens have been found by him near the South Fork of Cheyenne River in South Dakota, in the upper beds of that part of the Pierre formation that is below

the Judith River formation. The species was probably the largest that is at present known to have existed. From the length of the neck and the carapace Wieland estimates that the total length of type specimen was about 3.5 meters. Specimen in Yale University collection.

Of the remains of this great turtle the present writer has studied only the skull. The greater part of the description here given has been derived from Wieland's papers. The figures are reproduced from those papers. Fig. 260 represents the carapace as shown in Wieland's latest restoration of it (Amer. Jour. Sci., XV, p. 212). In this figure (p. 189) a large bone is shown in front as the nuchal but which the present writer regards as the entoplastron. This figure is based on the type specimen, except that the first rib is added from another individual. The carapace, so far as is known, was composed of 8 neurals, 1 or more suprapygals, 10 pairs of ribs, a nuchal, a pygal, and an undetermined number of pairs of peripherals.

The estimated total length of the carapace, exclusive of the nuchal, is 1.7 meters; with the nuchal, it was probably about 1.9 meters. The width, exclusive of the peripherals, must have been about 2 meters; including the peripherals, about 2.5 meters.

The neurals are mostly broader than long. Their borders are furnisht with long and coarse digitations, which interlock with others from the contiguous neurals and costal plates. It is difficult, therefore, to determine the widths of the neurals, but these widths may be taken as from 175 mm. to 225 mm. The neurals are relatively thin, being only about 5 mm. The median line of most of the neurals is markt by a deep and narrow groove, which becomes widest at the center of the neural. From this center there radiate outward characteristic surface striations. In his first description Wieland thought that these neurals probably consisted each of paired bones. He concluded also that the longitudinal groove was filled with horny materials and that the animal may have borne a row of dorsal spines. The last one or two neurals and the suprapygals have not been well determined. Little can be said concerning the pygal. Indeed, the terminal bone shown in Wieland's figures of the carapace is probably a suprapygal.

Rib.	Length.	Width at middle part.
2	950	75
3	1010	75
4	1020	78
5	1020	75
6	1010	70
7	——	65
8	——	60
9	——	55
10	——	50

The ribs and the costal plates resemble much those of *Protostega*. The disk formed of the costal plates and the neurals is much reduced, extending outward from the median line hardly one-fifth the distance to the ends of the ribs Beyond the borders of the disk the ribs are wholly free from one another. The first rib is extraordinarily large, as compared with the same rib in other turtles, being three-fourths as long as the second. Its length is 740 mm.; its diameter, about 75 mm. The other ribs have, in the type specimen, the dimensions shown in the table.

Where the ribs emerge from the disk their thickness averages only about 25 mm. It is thus seen that they increase much in thickness toward the middle of their length.

The bone described by Wieland (Amer. Jour. Sci., v., 1898, p. 17) as the nuchal (fig. 261) and now regarded by the present writer as such, is roughly triangular, with a concave anterior border. The lateral extent of the bone is 640 mm.; its antero-posterior extent, 250 mm. On the inferior surface there is a trapezoidal elevation, which Wieland regarded as having afforded an articulation with the last cervical vertebra. The thickness through the elevation is 35 mm.; elsewhere, from 10 mm. to 15 mm.

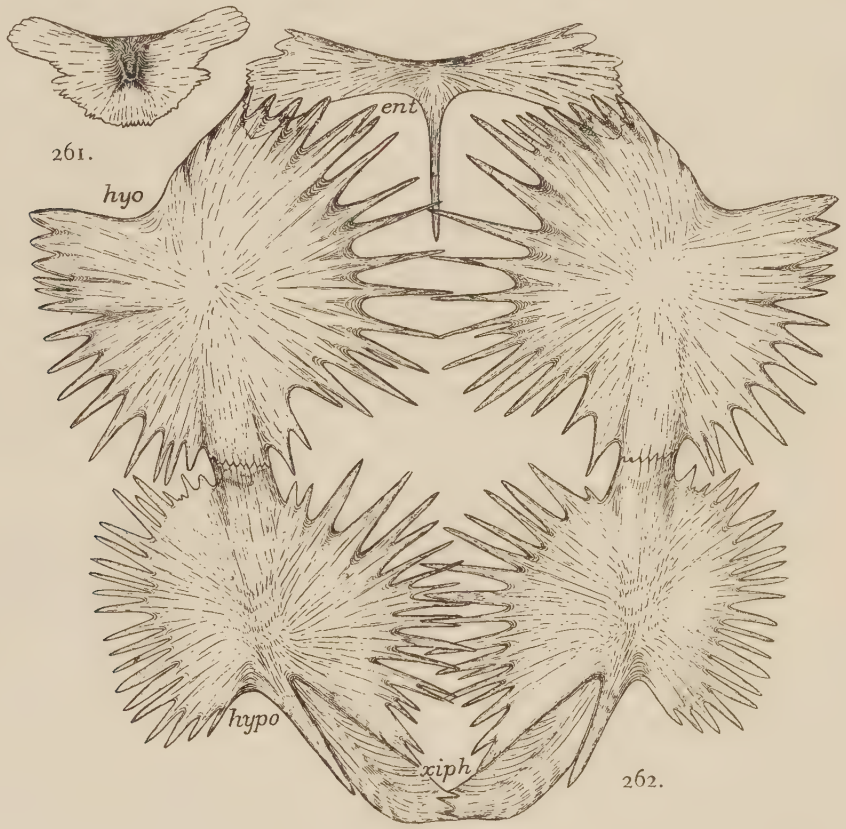
Little has yet been publisht about the peripherals. A fragment of one was figured by Wieland in his earliest description of this turtle. In a later paper (Amer. Jour. Sci., XV, p. 211) he states that the inner borders of these bones are strongly digitated.

The plastron (Amer. Jour. Sci., V, p. 16) has the same general structure as that of *Protostega*, altho the principal bones appear to have been broader and to come nearer filling up the median fontanel (fig. 262). As represented by Wieland, the digitations bordering them are extraordinarily numerous and elongated. The T-shaped entoplastron (fig. 262, *ent*) has a breadth of 940 mm. and a length of 450 mm. The anterior border is concave to the outer extremities, thus differing from that of *Protostega*. The extremities of the wings are 280 mm. wide. They appear in the figure to occupy their natural position on the hyoplastra. The

greatest thickness of the entoplastron, at the midline, is 60 mm.; at the narrowest part of the lateral portion, 50 mm. The epiplastra probably overlapt the entoplastral wings nearly to the midline and ran backward a short distance on the borders of the hyoplastra. Wieland (Ann. Carnegie Mus. IV, p. 8) describes what he regards as the epiplastron. For the present writer's opinion on this, the reader is referred to page 190.

The hyoplastra (fig. 262, *hyo*) have each an antero-posterior length of 1030 mm.; while the width, inclusive of the spines, is 1100 mm. The greatest thickness is 48 mm. The articulation with the hypoplastron is about 150 mm. wide.

The hypoplastron (fig. 262, *hypo*) from the hyoplastral articulation to the extremities of the processes embracing the xiphiplastron, has a length of about 960 mm. The greatest breadth, including the spines, is 1000 mm.; the greatest thickness is 41 mm.



FIGS. 261 AND 262.—*Archelon ischyros*. $\times\frac{1}{20}$. Nuchal bone and plastron of type.

261. Nuchal bone. 262. Plastron. *ent*, entoplastron; *hyo*, hyoplastron; *hypo*, hypoplastron; *xiph*, xiphiplastron.

The xiphiplastra (fig. 262, *xiph*) are each 500 mm. long, 170 mm. wide, and 36 mm. thick. The proximal end of each fits in between processes of the corresponding hypoplastron, being grooved to receive the borders of those processes. The distal ends of the two xiphiplastra join at the midline by interlocking digitations. These bones are less abruptly curved than are those of *Protostega*, and greatly resemble those of *Protostega advena*.

The total length of the plastron, according to Wieland's figure, is about 2100 mm., being thus longer than the estimated length of the carapace. The latter was certainly the longer.

The skull (fig. 263) of this species reacht an enormous size both relatively to the length of the carapace and absolutely. Wieland's restoration of the one studied by him is here reproduced. The same individual furnisht also a nearly complete skeleton. It was about three-fourths the size of the type specimen. The skull has a length of 720 mm. Another, but fragmentary specimen, indicated a skull fully a meter in length.

Points to be especially noted in this skull are its long and narrow form, the long preorbital region, the hookt beak, the posterior position of the orbits, and the upwardly directed nasal opening. Contrary to what is usually seen in turtles, the orbits are placed in the middle of the

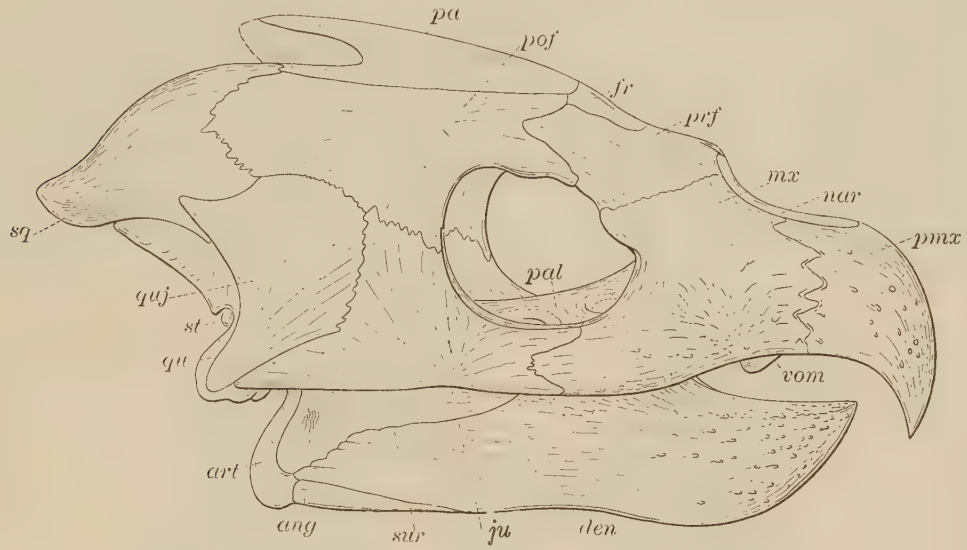
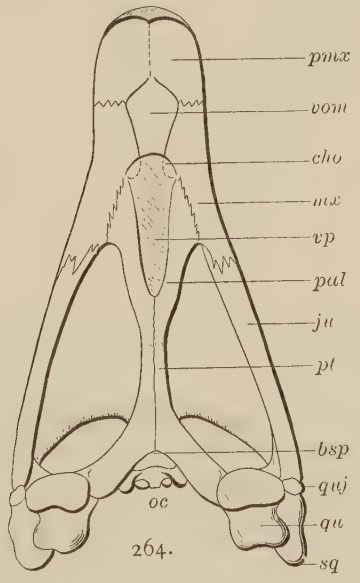


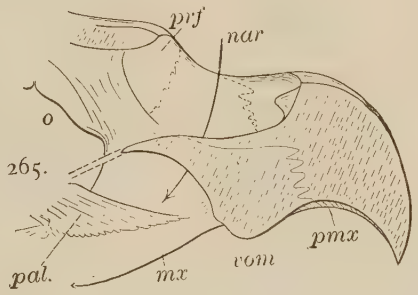
FIG. 263.—*Archelon ischyros*. Skull. $\times\frac{1}{6}$.

ang, angular; *art*, articular; *den*, dentary; *fr*, frontal; *ju*, jugal; *mx*, maxilla; *nar*, nares; *prf*, prefrontal; *pal*, palatine; *pmx*, premaxilla; *pa*, parietal; *pof*, postfrontal; *qu*, quadrate; *quj*, quadratojugal; *sq*, squamosal; *st*, stapedial rod; *sur*, supraangular; *vom*, vomer.

length of the head. This results from the great development of the preorbital region. The horizontal diameter of the orbit is 150 mm.

Both the maxillæ and the premaxillæ are greatly prolonged. The distance from the tip of the beak to the anterior rim of the orbit is 240 mm.; from the orbit to the suture between the





FIGS. 264 AND 265. *Archelon ischyros*. Skull.

264. Palatal surface. $\times\frac{1}{16}$. *bsp*, basisphenoid; *cho*, choanæ; *ju*, jugal; *mx*, maxilla; *oc*, occipital condyle; *pal*, palatine; *pmx*, premaxilla; *pt*, pterygoid; *qu*, quadrate; *quj*, quadratojugal; *sq*, squamosal; *vom*, vomer; *vp*, vomero-palatine region.

265. Side view of front. $\times\frac{1}{6}$. *mx*, maxilla; *nar*, nares; *o*, orbit; *pal*, palatine; *pmx*, premaxilla; *prf*, prefrontal; *vom*, vomer.

maxilla and the premaxilla is about 150 mm. The tip of the premaxillæ is bent down at nearly a right angle with the axis of the skull, forming a great hawk-like beak. The nasal opening looks wholly upward. Its length is 120 mm.; its width, 70 mm.

From the front of the orbit to the quadrate the free borders of the maxilla, the jugal, and the quadratojugal form a nearly straight line. Above the orbit the prefrontal meets the postfrontal, thus excluding the frontal from the orbital rim. The relations of the bones behind the orbit are in general like those of *Protostega*. In describing the quadratojugal of *Protostega* Case appears to have inverted the bone and this has led Wieland to suppose that the bone mentioned and others of the region are different in *Archelon*. Wieland's figure of the skull of *Protostega* shows that the region in question is the same in both genera. The squamosal is figured by Wieland as sending a process upward to meet the parietal. Probably the same occurs in *Protostega*. The supraoccipital is represented as very short, but there is probability that it was longer. The width across the quadrate region is about 350 mm.

Various interesting structures appear on the palatal surface of the skull (figs. 264, 265). As in *Protostega*, the basioccipital was small. The basisphenoid too appears to have been small, but it is not well known. The pterygoids are extremely narrow. The exact relationships

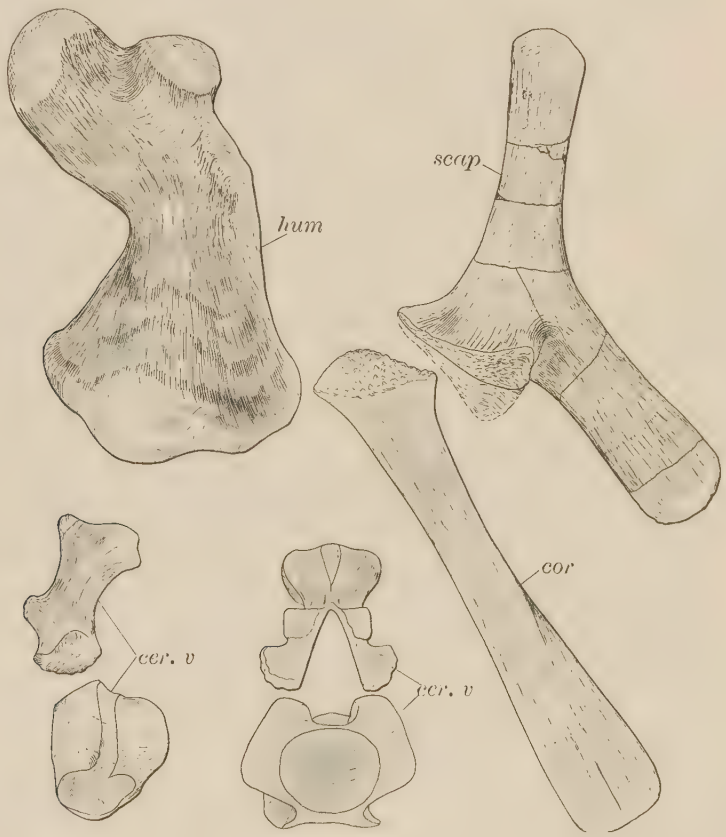


FIG. 266.—*Archelon ischyros*. Shoulder-girdle, humerus, and a cervical vertebra. $\times \frac{1}{10}$.

cer.v, third or fourth cervical vertebra; the figure on the right giving front view, that on the left a side view.
cor, coracoid; *hum*, humerus; *scap*, scapula.

of the palatines are not known. The hinder end of the vomer is missing, but it is probable that it interposed between the palatines. The choanæ were placed far forward, immediately below the external nares, and were not underfloored by the surrounding bones. The great crushing-surface of the upper jaw was developt mostly on the premaxillaries, an unusual thing among the turtles. On the maxilla this surface extends backward only to opposite the choanæ. Behind these, the free border of the maxilla is narrow and weak. The crushing-surface was therefore about 240 mm. long and about 140 mm. wide across the vomer. The anterior portion of the vomer formed a boss in the center of the crushing-surface.

The lower jaw (fig. 263) was massive. Its lateral halves were not co-ossified, thus differing from those of *Protostega*. The symphysis has a length of 120 mm., the total length of the jaw

being 465 mm. At the hinder end of the symphysis its depth is 110 mm., and the width of the jaw, 155 mm. On the under surface the symphysial end of the jaw turns strongly upward, but the upper surface rises little. Wieland found the splenial to be present.

Wieland has described 5 cervical vertebræ (fig. 266, *cer. v*) which belonged to the type specimen (Amer. Jour. Sci., II, p. 401; XIV, p. 102). These centra indicate a neck of great strength. The centrum of one, regarded as the third or the fourth, is procœlous, 95 mm. long and 140 mm. wide. Dorsal, sacral, and caudal vertebræ also are described by the same author.

The shoulder-girdle of the type specimen was described by Wieland (Amer. Jour. Sci., II, p. 404). The scapula (fig. 266, *scap*) is a stout and heavy bone, resembling that of *Protostega*. The length of the body of this bone, from the upper end to the glenoid fossa, is 450 mm. The coracoid (fig. 266, *cor*) is elongated and slender, as in *Protostega*. The length is 650 mm., the width of the distal end, 127 mm.

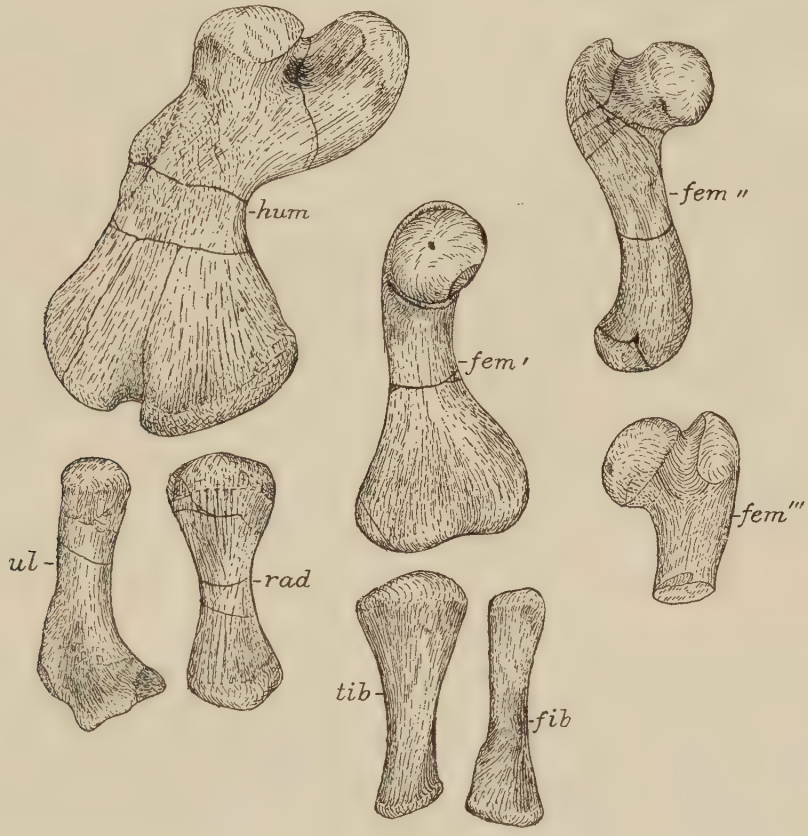


FIG. 267.—*Archelon ischyros*. Limb bones. $\times \frac{1}{10}$.

fem', left femur, dorsal surface; *fem''*, left femur, tibial border; *fem'''*, proximal end of left femur, fibular border; *fib*, fibula; *hum*, left humerus; *rad*, ulna; *tib*, tibia; *ul*, radius. The bones marked *rad* and *ul* should exchange places, be placed with the other ends up, and exchange explanatory letters.

The humerus (figs. 266, 267, *hum*) is an enormous bone, the length from the head being 580 mm.; the total length, 650 mm. The width of the distal end is 340 mm. This bone differs from that of *Protostega* in having a relatively smaller head and the radial process much reduced. Wieland describes also the radius, the ulna, and some phalangeal bones. The figures by Wieland are here reproduced. In the figure of the fore limb the upper ends of the ulna and the radius have mistakenly been represented as the lower. When the ends are reversed they will have the positions that they have in Wieland's figure of the anterior flipper of *Protostega gigas*. The bones must also exchange places and legends.

The pelvis of the type specimen is described and figured in the journal so often quoted (vol. IX, p. 247). The figure is here reproduced (fig. 268). This pelvis is of astonishing size, the length and the width being each nearly half the length of the carapace. In general, its

structure resembles that of the pelvis of the Cheloniidæ, but it differs in having a median bridge of bone connecting the pubes and the ischia. In this way ischio-pubic foramina are formed, but they are of small size. As stated by Wieland, the extreme antero-posterior length of the pelvis is 970 mm.; the extreme width, 810 mm. The fore-and-aft length of the pubis is 460 mm. The length of the ilium is 300 mm., and its diameter, at the middle of the shaft, is 105 mm.

The femur (fig. 267, *fem*) has the ratio to the humerus that it has in *Caretta caretta*. Its extreme length is 460 mm. The tibia (fig. 267, *tib*) has a length of 330 mm.; the fibula (fig. 267, *fib*) a length of 310 mm.

As in the case of *Protostega*, we can not doubt the adaptation of this turtle to marine aquatic life. Its excursions on land must have been confined to those for the deposition of

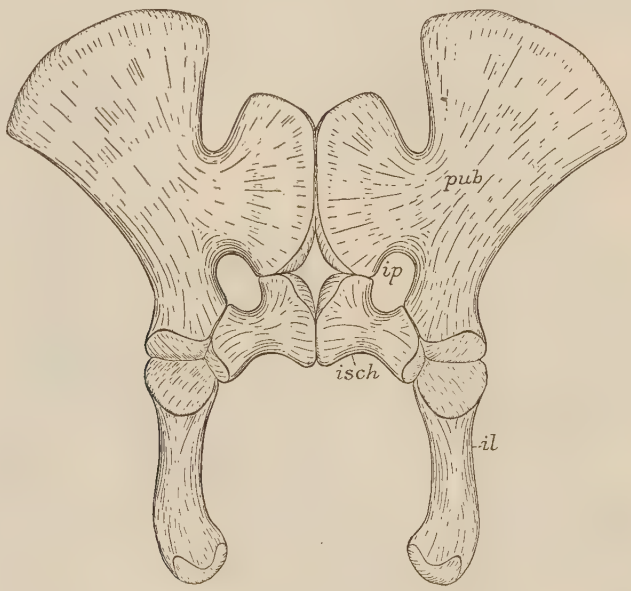


FIG. 268.—*Archelon ischyros*. Pelvis seen from below. $\times \frac{1}{10}$.

il, ilium; *ip*, ischio-pubic foramen; *isch*, ischium; *pub*, pubis.

its eggs. We can only speculate as to what extent it spent its life on the high seas away from the coasts. It seems probable that the broad and heavy body and the ponderous head were obstacles in the way of sustained journeys over rough seas. Its prolonged beak, furnisht with a broad crushing-surface, appears to indicate a diet, not of soft and actively swimming animals, but of mollusks and crustaceans. Associated with the fossil were various genera of tetrabranchiate cephalopods, and the jaws of the turtle seem to have been admirably adapted to pick up and crush such objects.

Archelon marshi Wieland.

Archelon marshii, WIELAND, Amer. Jour. Sci. (4), IX, 1900, p. 248; ibid., XV, 1903, p. 215.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 440.

This species was secured by Wieland in the upper beds of the Pierre formation, in South Dakota, on the east side of the South Fork of the Cheyenne river. It is described in the briefest terms. The remains are stated to consist of the plastron, the humerus, ribs, and a number of peripherals. These indicate a turtle about 11 feet in length. The humerus is said to be rather straighter than that of *A. ischyros* and the plastron relatively more massive, being fully one-half thicker than in the latter species.

Family CHELONIIDÆ Gray.

Thecophorous turtles fitted for life on the sea. Skull with temporal region extensively rooft over. No nasal bones. No posterior palatine foramina. Quadrate notcht behind for

the stapedial rod. Choanæ placed on the line joining the centers of the orbits; the nasal passages underfloored by plates from the vomer and the palatines. Neck short, head not retractile. Carapace heart-shaped, excavated in front for the neck and for the fore limbs; often with costo-peripheral fontanels. Plastron loosely and ligamentously joined to the carapace; usually with median and lateral fontanels. Entoplastron small and lance-shaped. Limbs unfitted for locomotion on the land; converted into paddles for swimming; the anterior the more powerful. Humerus straightened and flattened; with the head nearly in the axis of the bone and with the ulnar and radial processes nearly in the plane of the distal end; the radial process below and free from the head. Second to fifth fingers elongated, the phalanges without condyles; and all bound together in the skin and muscles. Claws 1 or 2.

At the present day the Cheloniidæ are represented by probably 4 genera (*Eretmochelys*, *Colpochelys*, *Caretta*, and *Chelonia*) and 5 or 6 species. Most, if not all, of these species enjoy a wide distribution, being found in all tropical and subtropical seas. All are seafaring animals, coming on the land only to deposit their eggs. They are mostly carnivorous in their food habits, but *Chelonia* feeds on vegetation.

If *Allopleuron hoffmanni*, of Holland, belongs to this family, as usually supposed, the family history extends backward to Upper Cretaceous times. Well-preserved remains of sea-turtles belonging to the divisions of the Tertiary are not common. In America we have a few species which are here assigned to the family with some doubt; such as those of *Peritresius* of the Upper Cretaceous of New Jersey and Georgia and *Lembonax* of the Eocene of New Jersey. It can hardly be doubted that *Syllomus crispatus* of the Miocene of Virginia belongs to the family; while it is probable that the species here called *Procolpochelys grandæva* and *Chelonia parvitecta* are also true Cheloniidæ. All of these are, however, imperfectly known. In Europe the known Tertiary forms are hardly more numerous or better known.

Allopleuron hoffmanni is greatly specialized in some respects. Especially is its carapace much reduced. It is improbable that from it have been derived the modern Cheloniidæ. It is more likely that the latter have descended from some Upper Cretaceous ancestor not distant from *Toxochelys*. The ancestors of *Allopleuron* must have become sea-turtles long before the Upper Cretaceous—consequently long anterior to the time when the ancestors of our modern Cheloniidæ could be called sea-turtles. It is therefore probable that *Allopleuron* really belongs to a family distinct from the Cheloniidæ.

Key to Genera here Described.

A. First costal articulating with peripherals. Shell coarsely sculptured as in some Trionychidæ ..... *Peritresius*
AA. Costal plates articulating to peripherals and sculptured ..... *Syllomus*
AAA. Costal bones, so far as known, not articulating with peripherals and not sculptured.
a. Plastral bones without median digitations ..... *Lembonax*
aa. Plastral bones with median digitations.
b. Some neurals in contact with three pairs of costals. Rib of first costal entering pit in third peripheral ..... *Procolpochelys*
bb. Neurals in contact with two pairs of costals. Rib of first costal entering pit in third peripheral ..... *Chelonia*

Genus PERITRESIUS Cope.

Carapace cordate, as in the Cheloniidæ generally; the anterior peripherals suturally joined to the costals of the first pair; the posterior peripherals joined to costals by gomphosis of ribs only; a high dorsal keel; surface of carapace coarsely sculptured.

Type: *Chelone ornatus* Leidy.

In 1882 (Proc. Amer. Philos. Soc., XX, p. 144) and again in 1884 (Vert. Tert. Form. West, p. 112) Cope characterized this genus as having 9 pairs of costals, 2 anterior peripherals joined to the costals, and a high dorsal keel. It is now evident that he had derived his information from a carapace sent to him by Dr. George Little, at one time State Geologist of Georgia (Amer. Naturalist, III, 1878, p. 129).

Cope arranged this genus among his Propleuridæ. The cordate form of the carapace in the state collection at Atlanta, deeply excavated in front and pointed behind, appears to indicate close relations with the Cheloniidæ, and to this family the species is here provisionally assigned.

Peritresius ornatus (Leidy).

Chelone ornatus, LEIDY, Proc. Acad. Nat. Sci. Phila. 1856, p. 303; Smithson. Contrib. Knowl., XIV, 1865, pp. 105, 119, plate xviii, fig. 10.

Peritresius ornatus, COPE, Cook's Geol. New Jersey, 1868 (1869), p. 735; Amer. Naturalist, III, 1869, p. 88; Ext. Batrach., Reptilia, Aves N. A., 1870, p. 150; Vert. Cret. Form. West, 1875, p. 260; Amer. Naturalist, III, 878, p. 129.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 441.

This is yet an imperfectly known species. It was based by Leidy on conjoined portions of two lateral peripherals, which had been found in Cretaceous greensand in Burlington County, New Jersey. This greensand probably, but not certainly, belonged to the upper bed. The bones are probably now in the collection of the Philadelphia Academy, but they have not been seen by the present writer. They were described by Leidy as measuring an inch and a half in breadth and as being wedge-shaped in section. The outer border was acute; the inner border grooved, and eight lines, about 17 mm., high. Both the upper and the lower surfaces were coarsely, but beautifully, tuberculated, and the tubercles showed a tendency toward a radiate arrangement. Some of the tubercles at the ends of the peripherals are lengthened out into ridges. Cope states that there were no indications of dermal sulci on the bones. He mentions also a costal which he thought belonged at least to the genus.

Under the species *Taphrosphys nodosus* the present writer has suggested that it may be identical with the species here described.

In the collection of the Geological Survey of Georgia is the greater portion of the carapace of what appears to have been a large sea-turtle. This specimen was at one time in the hands of Prof. E. D. Cope and was by him identified as *Peritresius ornatus* Leidy (Amer. Naturalist III, 1878, p. 129). Considering the facts that Leidy's type consisted of portions of two evidently hinder peripherals and that all the hinder peripherals of the Georgia specimen are wanting we can not be sure that the identification is correct. For the present it may be allowed to stand. Undoubtedly it was on this specimen that Cope based his definition of the genus *Peritresius*. It is not known why Cope concluded that there were 9 pairs of costals.

The specimen here described was found by Mr. Loughridge, of the Georgia Geological Survey, then under the direction of Dr. George Little, in the Ripley formation of the Upper Cretaceous, on Bonnahachee Creek, Stewart County, Georgia. It presents most of the carapace, but unfortunately the left side is yet concealed by a mass of matrix. This has prevented an accurate study of the specimen and the production of a figure. The length of the portion present is 675 mm. in a straight line, 735 mm. over the curve. The original length of the carapace must have been about 900 mm. In form the carapace is cordate, like that of *Caretta*. Anteriorly there is an excavation in the border 200 mm. wide and about 30 mm. deep. The free border is obtuse and the bone is about 16 mm. thick. The costals are about 8 mm. thick. The anterior peripherals are suturally joined to the first costals. Behind this they are missing; but it is evident that some of them were connected with the costals only by gomphosis of the ribs.

The most conspicuous feature of the carapace is the great dorsal keel. This begins on the nuchal bone and continues to the rear of the carapace. It is thick and obtuse on the anterior half of the carapace. Here the sloping sides of the keel are very steep, the summit is obtuse, and the height is about 36 mm. Posteriorly the summit is more acute.

On account of the great number of fractures it is difficult to follow the sutures. Where observed these are coarse and zigzag. A few of the sulci are traceable. The third vertebral scute has a width of about 125 mm. The sulci forming its lateral boundaries are nearly parallel with the axis of the animal.

The whole upper surface of the carapace is coarsely pitted and ridged, much like that of some species of Trionychidæ. 5 or 6 ridges are usually to be counted in a line 25 mm. long.

The anterior border of a second specimen is in the same collection. Found with it is the greater portion of the united dentary bones. The triturating surfaces are flat. The length of the symphysis is 53 mm.

The writer has been permitted to examine these specimens thru the courtesy of the present state geologist, Prof. William S. Yeates.

In the American Museum of Natural History is a small collection of bones, without indication of origin, but which are provisionally assigned to the present species. The number of the lot is 1410. They are a part of the Cope collection and evidently were found in New Jersey. These bones are filled with iron pyrites and they are black, with some surface stain of chocolate. One fragment is that of a costal. The sutural border is 12 mm. thick, but thru the rib the thickness is 17 mm. The upper surface is covered with coarse ridges and tubercles, irregular in size and arrangement. They resemble greatly those of *Amyda virginiana* illustrated on plate 96, figs. 7, 8. Another fragment appears to be the upper end of a costal, with the base of the rib-head. The thickness varies from 7 mm. to 10 mm. The fragment is 75 mm. wide. Another piece seems to be a part of a peripheral, showing the acute free border, but not extending to the costal border. The length of the fragment is 56 mm.; the width, 63 mm.; the thickness of the upper border, 21 mm. The upper surface is convex from the free border upward, while the lower surface is concave. One end appears to have come close to the suture, and here the tubercles run at right angles with the suture. Those at the outer end are small and less elongated. Between the two regions are some ridges running at right angles with the free border.

Three fragments belong to the plastron. The best of these resembles the outer end of the left hyoplastron of the loggerhead. The fragment is 135 mm. long, 67 mm. wide, and 20 mm. thick at the proximal end. Toward the outer end the bone thins and ends in a number of digitations. The border, supposed to be axillary, is concave in outline, with the edge obtuse near the digitations, but subacute more proximally. The supposed hinder border evidently articulated with another bone, probably the hypoplastron, out nearly to the digitated border, thus abolishing the fontanel. The greater part of the inferior surface of the bone is ornamented with anastamosing ridges and some tubercles, about three or four of them lying along a line 20 mm. long.

Genus SYLLOMUS Cope.

Costal bones suturally articulated with the peripherals. Surface of carapace sculptured with grooves and ridges. Humerus much flattened distally. Ectepicondylar passage a complete foramen. Radial process remote from head of bone.

Type: *Syllomus crispatus* Cope.

Syllomus crispatus Cope.

Plate 32, figs. 1, 2; text-fig. 269.

Syllomus crispatus, Cope, Proc. Amer. Philos. Soc., xxxv, 1896, p. 139.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 442.

The remains on which this species was based are now in the American Museum of Natural History and bear the number 6134. These remains consist of the right humerus, lacking only the ulnar process, and 2 fragments of costals. These were collected by Cope in Miocene deposits, on the Pamunkey River, Virginia.

The first fragment of costal belongs to the distal end of the bone (plate 32, fig. 1). The width at the end is 47 mm., but this diminishes proximally. The thickness at the proximal end of the fragment is 6 mm.; but at the distal end this has become only 2 mm. This border articulated by close suture with the contiguous peripheral. Doubtless the rib passed beyond the border and entered a pit in the peripheral. The surface of the bone is sculptured with anastomosing grooves and ridges, usually parallel with the long axis of the costal. The sculpture becomes coarser toward the proximal end of the bone. Parallel with and close to the peripheral border is a shallow groove which may be a portion of a costo-peripheral sulcus.

The other fragment of costal comes from near the neural end (plate 32, fig. 2) and the width is 45 mm. It is crost by a narrow, but sharp, ridge, which indicates that the carapace was traverst on each side by a lateral keel. We may also safely assume that there was a median keel. The thickness of the bone, on what is probably the proximal side of the keel, is 7 mm. Toward the distal end the thickness diminishes. The surface of this fragment is more coarsely and irregularly sculptured than that of the other and the elevations vary more in size and form. No trace of sulci appears on this fragment. A portion of the surface is, however, destroyed.

The humerus (fig. 269) resembles that of a true sea-turtle. The total length is 100 mm. The distal end is broad and flat. The head of the bone is elongated reniform, the long axis being at nearly right angles with the plane of the distal end. Its long diameter is 32 mm.; the shorter, 17 mm. The ulnar process is broken away, but a groove separated it distinctly from the head. The radial process is divided into two portions; one part being on the under side of the shaft, 40 mm. below the upper border of the head; the other part on the radial border, still further down on the shaft. Both portions are prominent. The narrowest part of the shaft is 20 mm. wide and 11 mm. thick. The distal end is 41 mm. wide. The ectepicondylar passage is a foramen. It emerges on the lower side of the bone 10 mm. above the distal extremity. The condyles are distinctly separated from the surrounding bone. Their fore-and-aft extent is 22 mm. The radial epicondyle is broad, thick, and flat; the ulnar little prominent. It is remarkable that Cope in his description of this bone regarded the anterior border as the posterior.

FIG. 269.—*Syllomus crispatus*. Right humerus. Type. $\times\frac{2}{3}$.

On left, the ventral surface; on right, the radial border.

Genus LEMBONAX Cope.

Plastron with probably a fontanel extending from the entoplastron to the xiphiplastra. No digitations of bone proceeding from the plastral bones toward the midline. Epiplastra firmly sutured to the hyoplastra, the suture oblique to the midline; the xiphiplastra similarly joined to the hypoplastra, the suture at right angles with the midline.

Type: *Lembonax polemicus* Cope.

The position of this genus is very problematical. Cope concluded originally that the relationships were with the Chelydridæ rather than with the Cheloniidæ. At a later time he stated (Amer. Naturalist, XVI, 1882, p. 989) that not enough was yet known to assure us to what family the genus belonged, except that they were not Trionychidæ. Nothing has been added to our knowledge on that point since that time. Cope referred two additional species, *L. propylæus* and *L. insularis*, to the genus. While the present writer retains these species in this genus provisionally, there appears to be no evidence whatever that they belong there.

For want of knowledge where *Lembonax polemicus* belongs it is here referred to the Cheloniidæ.

Lembonax polemicus Cope.

Fig. 270.

Lembonax polemicus, COPE, Ext. Batrach., Reptilia, Aves N. A., 1870, p. 168.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

This species was sent to Professor Cope from the Eocene greensand near Farmingdale, Monmouth County, New Jersey. The type and only known specimen is now in the American Museum of Natural History and bears the number 1134. It furnishes a portion of the plastron and the base of the scapula. The materials indicate a large individual, but they furnish meager information regarding its structure and relationships.

The most important parts of the plastron are a portion of the right hyoplastron and a portion of the right hypoplastron. The outer borders of both these bones are wanting.

The hyoplastral fragment (fig. 270) has at present a length of 233 mm., having apparently lost a slight portion since it was studied by Cope. The greatest width is 136 mm. The thickness varies from 10 to 15 mm. Anteriorly the bone terminates at the union with the epiplastron. Posteriorly, there is no indication of suture with the hypoplastron, and this may have been farther away than indicated in the figure. The inner border of the bone is thick,

obtuse, and along the hinder third is somewhat dentated. Anteriorly, the upper surface is furnisht with ridges which are sharp and prominent as they approach the free inner border, but which become obsolete in the opposite direction. These ridges seem to diverge from the anterior buttress of the hyoplastron (fig. 270, *C*), if such existed. At the anterior end of the bone the inner border turns slightly outward and, at an angle of about 75°, meets the sutural border for articulation with the epiplastron (fig. 270, *A* to *B*). These bones were not joined by squamosal suture, as they are in the Cheloniidæ and the Chelydridæ, but by dentated suture. The lower surface of the bone is smooth and convex, especially transversely. The upper surface is concave. At the anterior end of the bone, on the upper surface, 190 mm. behind the anterior end (fig. 270, *C*), is a slight elevation, as if it were the base of an axillary buttress. The lower surface of the bone just behind this point also indicates that the plastron rose toward the carapace.

FIG. 270.—*Lembonax polemicus*. Portion of plastron. Type. ×¼. No. 1134 A. M. N. H.

A to *B*, border for articulation with the epiplastron; *C*, base of axillary buttress; *D*, probable base of inguinal buttress; *hyo*, hyoplastron; *hypo*, hypoplastron.

The portion of hypoplastron has a length of 155 mm. and a width of 125 mm. Anteriorly the suture for the hyoplastron is missing. The inner border is subacute and smooth, thus differing from the corresponding border of the hyoplastron. The suture for the xiphiplastron runs at right angles with the midline. It shows that the two bones were firmly united by coarse interdigitating teeth. Toward the outer border the bone has a thickness of about 13 mm., but this diminishes slowly toward the inner border. As the outer border is approacht, the bone begins to ascend in a decided manner, as if approaching the carapace (fig. 270, *D*). If this conclusion is correct, as indicated by both hyoplastron and hypoplastron, these bones were, relatively to their length, very narrow; and there is indicated a wide fontanel, that extended from the entoplastron to the xiphiplastra. It seems improbable that the inner borders came into close proximity. There were certainly no digitations extending from the hyoplastron and hypoplastron toward the midline, as there are in the Cheloniidæ and the Chelydridæ.

A fragment of bone present indicates that the hyohypoplastral suture was formed by the interdigitation of finer processes than that of the hypoxiphiplastral suture. On the anterior end of the fragment of hypoplastron there are traces of this suture, so that this bone appears to have had a fore-and-aft extent of about 170 mm.

The fragment of scapula present was that of a very large turtle. It is possible that it did not belong to the same individual as the plastral bones. The long diameter of the neck of the bone is 98 mm.; the short diameter, 42 mm.

Lembonax? insularis Cope.

Fig. 271.

Lembonax insularis, COPE, Proc. Acad. Nat. Sci. Phila. 1872, p. 16.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

Professor Cope's materials representing this species were meager and his descriptions of it unsatisfactory. Nor have the means for increasing our knowledge of it been augmented; they have even been reduced. In the American Museum of Natural History there is a lot of bones labeled by Cope as the type of his *Lembonax insularis*, and bearing the museum's number 2347. This lot came to Cope from the Eocene bed of greensand at Vincentown, Burlington County, New Jersey. Cope stated that the species was based on nuchal and

peripheral bones; but he also exprest doubt whether these bones might not rather belong to the rear of the carapace. Among the bones in the lot mentioned there is none that can be recognized as a bone belonging in the midline. Fragments are found which, when fitted together, furnish fig. 271. The bone markt by 1 is certainly that called by Cope the first marginal. It seems impossible to determine just where it belonged. It is, for various reasons, improbable that it belonged in front. Hence, assuming that Cope had a symmetrical bone which joined the supposed first peripheral, the latter is here taken to belong behind and to be the last left peripheral.

Cope estimated the length of the bone 1 to be 153 mm. It is not known whether he took account of the narrow fragment on the right of the figure; but there is no doubt that this fragment belongs where it is placed. The length of the bone then, not including a deeper plate on the right that would be hidden when the bone joined the one next to it, is 165 mm. The greatest width, omitting a deep sutural plate, is 100 mm. The thickness on the right side is 27 mm. The greatest thickness is to the left of the middle of the length and is 45 mm. Cope states that this is the thickness near the suture of the second peripheral; from which expression we may infer that the narrow fragment on the left of the figure, markt 2, is a part of the penultimate peripheral. The free border of the bone 1, so far as represented, is thick and obtuse. Fig. 271 gives a section from *a* to *b*. The free border of this bone, on the left, projected in an obtuse angle. It appears improbable that such an irregular border would be found on the front of the carapace. The upper surface is convex and undulating, but there is no definite sculpture. Toward the free border the surface is pitted and rough.

FIG. 271.—*Lembonax insularis*. Fragments of two bones of the carapace, with section of one. Type. $\times\frac{1}{3}$.

a to *b*, direction of section. 1, probable last peripheral; 2, probable penultimate peripheral.

Seen from below the bone is concave. Near the hinder border of the narrow fragment on the right is a prominent ridge. A suspicion is awakened that this is the fragment which Cope mentions as bearing the support of a vertebra. The ridge mentioned continues for some distance on the larger part of the bone of which the fragment is a part. Behind it, on the larger fragment, are two equally prominent ridges, followed by some smaller ones, and these are separated by deep grooves. What is the meaning of these grooves and ridges can not be determined. It is possible that the median bone, whether nuchal or pygal, sent a process along the under surface of the bone 1, two-thirds its length.

The bone shown on the left of the one indicated by 1 has a thickness of 33 mm.; and it is possible that this is a part of what Cope called the nuchal. In that case the bone 1 would be either the right ultimate peripheral, or first left peripheral.

As in the case of *L.? propylæus*, it is impossible to state with certainty that this species belongs to the genus *Lembonax*.

Lembonax? propylæus Cope.

Fig. 272.

Lembonax propylæus, COPE, Proc. Acad. Nat. Sci., Phila. 1872, p. 15.
Lembonax prophylæus, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

The type of this species is now in the American Museum of Natural History, and has received the number 1310. This specimen was found in the Eocene greensand, in the vicinity of Farmingdale, Monmouth County, New Jersey, the same formation and locality that furnisht the type of the genus, *L. polemicus*.

The type specimen (fig. 272), all that is known of the species, consists of a nuchal bone, a considerable part of the first left peripheral, and a fragment of the right.

The species is remarkable on account of the great excavation in the front of the nuchal, reminding us of that of the nuchal of *Allopleuron hoffmani* (Gray). The individual was a large one, the distance between the extremities of the nuchal being about 225 mm. The antero-posterior extent of the bone, at the midline, is 105 mm. The thickness on the midline and halfway between the fore and hinder borders is 25 mm. The anterior border is subacute, except toward the extremities, where it becomes thick and obtuse. In the hinder border there is a notch for the front end of the first neural bone.

The border for union with the first peripheral is beveled, so that the first peripheral somewhat overlaps the nuchal. The suture between the two bones is a coarse one. A portion of the border for union with the first costal presents a kind of tongue-and-groove joint, there being on the edge of the nuchal 2 grooves and 3 slightly projecting laminæ.

The upper surface of the bone is smooth and there are no traces seen of the presence of sulci. On the under side of the bone, there is, on the midline near the hinder border, an eleva-

FIG. 272.—*Lembonax propylæus*. Nuchal and portions of right and left first peripherals. Type. $\times\frac{1}{3}$.

tion that probably furnisht an articulation for the neural spine of the first dorsal vertebra. There is no surface for articulation with the last cervical, such as is found in the living Cheloniidæ.

Cope referred this species unqualifiedly to the genus *Lembonax* and stated that it threw much light on the character of the genus. As there are no carapacial bones accompanying the type of *L. polemicus* and no plastral bones accompanying the type of his *L. propylæus*, it is difficult to understand why they should be so confidently referred to the same genus. On the other hand, it is possible that both types belong to the same species.

Genus PROCOLPOCHELYS nov.

An imperfectly known genus of Cheloniidæ. Shell large, with thick and heavy neurals and costals; two or three pairs of costals articulating each with 3 neurals. The neurals probably exceeding 8 in number. First costal plate of each side suturally articulated with the nuchal and the first peripheral; its rib-end entering pit in third peripheral. Large fontanels between the costals and all the peripherals behind the first.

Type: *Chelonia grandæva* Leidy.

The known materials of the type of this genus lack much of yielding a satisfactory knowledge of the characters of the genus. Nevertheless, it seems evident that Leidy's species does not belong to the same genus as *Chelonia mydas*. Cope referred the species to his genus *Puppigerus;* but, inasmuch as Lydekker in 1889 (Cat. Foss. Reptilia, III, p. 52) made *Chelone*

longiceps the type of *Puppigerus*, and the latter is not congeneric with *Chelonia grandæva*, this species can not be placed under *Puppigerus*.

A study of the known materials of *Chelonia grandæva* makes it apparent that the first costal bone was articulated with the nuchal and the first peripheral of each side and that some of the costals were articulated proximally with 3 neurals each. In these respects the species differs from any belonging to either *Chelonia*, *Eretmochelys*, or *Caretta*.

As regards the relations of the costals to the neurals, we find similar conditions in a specimen of *Colpochelys kempi* in the American Museum of Natural History. In this there are apparently 13 neurals, and the costals of the third, fourth, fifth and sixth pairs articulate each with 3 of these neurals. Nevertheless, nearly all the neurals are hexagonal, none octagonal, as in *Testudo*, where some costals articulate with 3 neurals.

On a comparison of the widths of the costals with the lengths of the neurals we find a confirmation of the conclusion that there were, as in *Colpochelys*, more than 8 neurals.

But while agreeing with *Colpochelys* in these respects *Procolpochelys* differs from it in another. In *Colpochelys* the end of the rib of the first costal bone enters a pit in the fourth or fifth peripheral, while in *Procolpochelys grandæva*, as in most Cheloniidæ, the end of the first costal rib enters a pit in the third peripheral.

Procolpochelys is therefore distinguisht from all the hitherto recognized genera of Cheloniidæ.

On pages 8, 9, and 10 *Colpochelys kempi* has been referred to the genus *Lepidochelys*.

FIGS. 273 AND 274.—*Procolpochelys grandæva*. Neurals. ×⅔.

273. Two neural bones. Type. 274. Neural. No. 1027 A. M. N. H.

Procolpochelys grandæva (Leidy).

Figs. 273–280.

Chelonia grandæva, LEIDY, Proc. Acad. Nat. Sci. Phila., v, 1851, p. 329; Ibid., VIII, 1856, p. 303.—COPE, Cook's Geol. New Jersey, 1868 (1869), p. 738; Ext. Batrach., Reptilia, and Aves N. A., 1870, p. 153, figs. 40, 41.—MAACK, Palæontographica, XVIII, 1869, p. 283.

Puppigerus grandævus, COPE, Ext. Batrach., etc., 1870, p. 235; Proc. Amer. Philos. Soc., XIV, 1875, p. 363.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 443.

Dr. Leidy's *Chelonia grandæva* is an insufficiently known species. The type belongs to the Philadelphia Academy. It consists of three neural bones which had been found in what is regarded as Miocene marl, in Salem County, New Jersey. One of these neurals appeared to Leidy to be the first. A portion of the anterior end had been broken off, yet the part that remained was 67 mm. long and 48 mm. wide. The other two neurals were hexagonal, as wide as long or wider, and each had a posterior process, showing that some of the neurals were sharply notcht in front. One of these (fig. 273, *a*) was 54 mm. long, 67 mm. wide, and 15.5 mm. thick; the other (fig. 273, *b*) was 58 mm. long, including the process, and 58 mm. wide.

Cope, in 1870, as cited, further described the species. He had some fragments of costals; a fragment of probably the nuchal; the scapula, which he figured; and what he described as the femur, but which was evidently the humerus, as indeed he says it was in his explanation

of the figures on page ii. These came from Shiloh, Cumberland County, New Jersey. These specimens are now in the American Museum and have the number 1319. The scapula resembles that of *Caretta*, except that the upper end is more flattened. The humerus is now missing from this lot of bones. The radial process is stated to have been on the shaft some distance below the head. The costal plate is 82 mm. wide and 13 mm. thick. This and other fragments of the costals show that these bones were not suturally joined to the peripherals; but also that there was no considerable interval between them, the projection of the rib being short. With this lot is the "nuchal or marginal vertebral" mentioned by Cope. It appears to be the left end of the nuchal. The thickness at the median end of the fragment is 15 mm., that near the junction with the first costal, 21 mm. The first peripheral sent a thin process for some distance beneath the nuchal, near the anterior border.

Cope mentions another specimen, belonging to the Philadelphia Academy, which presented 4 peripherals and a fragment of a hypoplastral. A peripheral, believed to be the third, had a length of about 47 mm., and a width of 21 mm. Cope concluded that the rib of the first costal did not run parallel with the hinder border of the costal, but approacht the hinder border toward the distal end. Another peripheral belonging near the middle of the series was trigonal in section, measuring 59 mm. across the lower face and 45 mm. across the inner, or visceral, face. This and two other peripherals were emarginate at the middle of the outer border. The dermal sulcus crost the peripherals a little behind the middle.

In the American Museum of Natural History is a lot of fragments labeled by Cope as belonging to this species. The catalog number is 1027; the locality uncertain, but probably in New Jersey. A neural appears to confirm Cope's determination. This neural (fig. 274) is 63 mm. long, in the midline of the upper surface and including the process. The width is 71 mm.; the thickness, 16 mm. The anterior border is beveled so that the neural was overlapt somewhat by the preceding neural; and the hinder border similarly overlapt the succeeding one. A peripheral, probably the second, is 85 mm. long, 47 mm. wide at the middle of the length, and 20 mm. thick. The outer border is obtuse; the inner, acute (fig. 275). Fragments of three other peripherals belonged probably near the rear of the carapace; at least, they have a much narrower visceral face than those described by Cope. One has the upper and lower faces 48 mm. wide; the inner face only 19 mm. The other bones throw little or no additional light on the species.

In the paleontological collection at Princeton University is a lot of turtle bones that are labeled as having been received in December, 1879, from Mr. George Erety Shoemaker, now of Philadelphia. This gentleman writes that these remains came from a marl bed near Shiloh, Cumberland County, New Jersey. This marl belongs to the Miocene. While there is a large amount of this material, it unfortunately consists of the remains of at least four turtles, belonging apparently to 2 genera. It has been found impracticable to separate these satisfactorily, but apparently there are parts of 3 individuals of the present species.

With these bones are 2 neurals which, it can hardly be doubted, belong to *P. grandæva*. One of these is 50 mm. long, with a short posterior spine, 48 mm. wide, and 12 mm. thick. To it is attacht the neural arch. Another, a more posterior and smaller one, is 32 mm. long and 44 mm. wide. Two other neurals present are only 8 mm. thick and evidently belong to a quite different turtle.

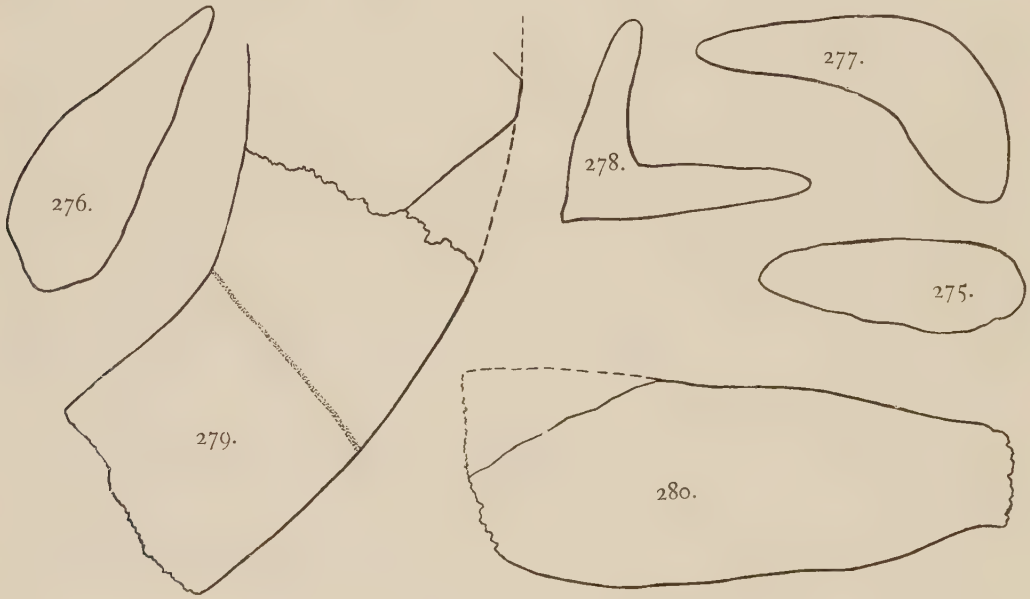
There are in the lot, belonging apparently to *P. grandæva*, at least five proximal ends of costals, and most of these show that they articulated each with three neurals, of which the median one was the smaller. These costals vary in width from 80 mm. to 105 mm. and in thickness from 10 mm. to 14 mm. The rib-heads were large. Besides the proximal ends of costals, there are many other portions of these bones. A part of a right first costal requires description. The proximal end is missing. Near the distal end the width is 110 mm.; the thickness 12 mm. The anterior border articulated with the nuchal and with the first peripheral, the two sutural borders making between them an angle of about 135°. The remainder of the distal border, 65 mm., was free from the adjacent peripheral, the second. Near the hinder border issues the rib, making its way to the pit in the third peripheral. Only a portion of the second costal has been recognized. Another costal, probably the fourth, is represented by the distal two-thirds. The distal end is 133 mm. wide; the other extremity, 111 mm. The thickness, at a distance of 85 mm. above the free border, is 18 mm.; but at the proximal end

of the fragment, only 12 mm. The sutures are very jagged. Nearer one sutural border a sulcus descends, which separated two costal scutes. Two other costals measure each 72 mm. in width at the distal end. In all these the free end of the rib projected beyond the distal border.

A nuchal is represented by the greater part including the entire front. There was an articular tuberosity for the eighth cervical; the anterior border of this bone was 200 mm. long. It is excavated somewhat for the neck and head. The upper surface is quite convex from side to side. Antero-posteriorly the bone measures 96 mm. The front border is obtuse; behind it a short distance the thickness is 16 mm., increasing at the ends of the bone to 20 mm. The hinder border joined suturally the first costal bone.

The first left peripheral is connected with the nuchal. It is 110 mm. long and 80 mm. wide. The hinder border articulated with the first costal. The free border is obtuse and the distal end is 18 mm. thick. There is present the proximal end of another left first peripheral which is considerably thicker than the one just described.

What are evidently right and left second peripherals, of an individual smaller than either of the above, are present. The proximal end of the one of the left side is 65 mm. wide, whereas the distal end of the left first, described above, is 72 mm. wide; besides, the two do not fit



FIGS. 275–280.—*Procolpochelys grandæva*. Various peripherals. $\times\frac{2}{3}$.

275. Section across middle of supposed second peripheral; free border toward right. No. 1027 A. M. N. H.
276. Section at anterior end of second peripheral. Princeton Univ. Coll.
277. Section near hinder end of third peripheral. Princeton Univ. Coll.
278. Section near front end of supposed fifth peripheral. Princeton Univ. Coll.
279. Right hinder peripheral, view above. Princeton Univ. Coll.
280. Upper surface of supposed eleventh peripheral. Princeton Univ. Coll.

together as they should if they belonged to the same individual. No differences are seen that indicate different species. This second peripheral (fig. 276) is 95 mm. long, 64 mm. wide and 22 mm. thick proximally; 51 mm. wide and 25 mm. thick distally. The anterior border is obtuse, the hinder acute and with suture for a costal. The succeeding, or third, peripherals are joined to those just described. They measure about 95 mm. along the free border and are 70 mm. wide at the distal end. A ridge that begins on the inferior surface of the second becomes more conspicuous near the outer border of the anterior half of the third; and just above it, near the front of the bone, is the pit for the rib of the first costal. Fig. 277 is a section at the hinder end of this peripheral.

There are present nineteen peripherals, not counting the part of a first which belongs to the larger individual. At least three are not at all represented; but at least two that are

present on one side are not represented by their fellows of the opposite side. There is therefore both a redundancy and a shortage. Evidently neither fourth peripheral is present. There are representatives of 3 peripherals, probably the fifth, sixth, and seventh of the left side. The supposed fifth (fig. 278) is 99 mm. long and consists of two plates which meet each other at an acute free border. The two succeeding this, the sixth and the seventh, are damaged, but the faces make a smaller angle with each other. The fifth presents an extremely shallow rib-pit, located in the hinder half of the length. It is highly probable that these peripherals belong to a turtle of some other genus.

On the left side are three peripherals following in their natural order. Each of these has three faces, a somewhat convex upper face, a flat lower face, and a channeled visceral face. The rib-pit of the first one is a little behind the middle of the length. This bone resembles one in lot number 2215, of the American Museum mentioned above; but both sides of the latter are flat. The bone under description is 125 mm. long, 64 mm. wide in front, and 22 mm. thick. The next one is a very little shorter and slightly narrower. It presents no pit. This is in the front end of the next peripheral, close to the suture. This next bone is 115 mm. long, 46 mm. wide anteriorly and 21 mm. thick. In general, the section of it resembles that of the first of the three here described. Bones corresponding to the second and third of those just described appear to be represented on the right side of the animal. On this side the pit which was in the front end of this third of the side is moved forward to the left junction between the two bones. On this side, too, the hinder of the two is broken, but both ends of it appear to be present. Following what almost certainly is its hinder end is a similar peripheral, with its hinder end missing. This bone has a small pit for a rib. The inner, or visceral face, is 21 mm. wide.

Besides these peripherals there are four others present which require consideration. Two of these are corresponding bones of opposite sides. Fig. 279 represents the one taken to belong to the right side. It will be observed that there is a decided change in the direction of the curve at the supposed anterior end. This bone is 88 mm. long and 48 mm. wide at the sulcus. On its channeled inner face, at the end of the sulcus, is a deep pit for a rib. A portion of another peripheral is attacht to what is supposed to be the anterior end of this curved peripheral. Its inner face is narrower.

The curved peripheral of the other side has, at some period of life, had the supposed anterior end damaged, so that it has the appearance of having formed a false joint with its contiguous peripheral. Attacht to the hinder end of this bone is another peripheral (fig. 280) whose fellow is not present. It is 105 mm. long. The inner face is channeled but there is no pit. One end, supposed to be the posterior, is narrow—only 24 mm. wide. It is probable that this bone is the eleventh and that the narrow end joined the pygal.

To add to the difficulties, there is present what appears to be the left half of a pygal bone. This was 86 mm. wide and 65 mm. high. It articulated suturally with a suprapygal and laterally by its whole height with the contiguous peripherals, the eleventh pair; but certainly not with the one regarded above as the eleventh.

Portions of a large thick plastron are present. One piece may be part of a hyoplastron. A free border, probably the outer, is digitated. One border articulated suturally with another bone, supposedly the hypoplastron.

On the nuchal bone the sulcus bounding posteriorly the nuchal scute or the first marginal is 44 mm. behind the free border, near the midline and 54 mm. from the border at the outer end of the bone. The limits of the nuchal scute can not be made out. On the first and second peripherals the costo-marginal sulcus is seen running nearer the costal margins of the bones than the free margins. Posterior to these the costo-marginal sulci doubtless lay on the intervals between the costal and peripheral bones. Each peripheral is crost by a sulcus separating two marginals.

The outer surfaces of all the bones are smooth, except that they are markt by numerous vascular grooves.

In the paleontological collection at Rutgers College, New Brunswick, New Jersey, are found one peripheral and one complete costal which are labeled as belonging to this species and as having come from the Miocene marl at Tinton Falls. There is probably an error in the locality.

The peripheral appears to be the second of the series. Its length is 116 mm.; its greatest width, 66 mm.; and the thickness, 22 mm. This is reduced gradually to the acute hinder border. The anterior border is obtuse.

The length of the costal, omitting the portion of the rib projecting from the peripheral border, is 220 mm. The width is 87 mm.; the thickness 11 mm. at the proximal end, 14 mm. distally. Proximally the costal articulated with 3 peripherals, as we have found to be the case with some of the costals of the Princeton specimen. The middle and smallest of these neurals was crost by a sulcus which divided two vertebral scutes. This sulcus is 36 mm. long on the costal, a fact that indicates that the vertebral scutes were not wide.

The surface of the bone is smooth, but markt by vascular grooves. The distal border was not articulated to the peripherals, except by gomphosis of the end of the rib.

Genus CHELONIA Brongniart.

Cheloniidæ with persisting costo-peripheral fontanels; four pairs of costal scutes; jaws not hookt; the grinding-surface of each maxilla with a prominent tuberculated ridge which terminates in front in a sharp tooth and which does not extend on the narrow premaxilla. Limbs each usually with a single claw.

Type: *Chelonia mydas* (Linnæus).

To this genus there is assigned, with doubt, a single species of North American fossil turtles. It is that called by Cope *Puppigerus parvitectus*. In the writer's Bibliography and Catalogue, 1902, p. 443, this species and Leidy's *Chelonia grandæva* were catalogged under the genus *Puppigerus*; and he would be glad to retain them there were it possible. In that work it was stated that the type of *Puppigerus* was Leidy's *Chelonia grandæva*; but the fact was overlookt that Mr. Richard Lydekker had, in 1889, chosen as the type of that genus Owen's *Chelone longiceps*. According to Lydekker, *Puppigerus* becomes a synonym of *Lytoloma* Cope. It is possible that such is the case; but it appears more probable that *Puppigerus* is a distinct genus, with *P. longiceps* as its type. The writer can not believe that Leidy's *C. grandæva* is congeneric with *P. longiceps* and he has for that reason proposed for *C. grandæva* the generic name *Procolpochelys*. Furthermore it is improbable that *parvitecta* belongs in the same genus as Leidy's *grandæva*.

About the only reasons for placing the species *parvitecta* under *Chelonia* are that we thus avoid erecting a new genus on extremely insufficient materials and that we return the species to the genus to which it was originally referred, which genus is probably not far from the true one yet to be establisht.

On page 143 of the Proceedings of the Philadelphia Academy for 1867, Cope described fragments of what he regarded as two species of *Chelone*; but he applied no specific names to these. In the Miocene volume of the Maryland Geological Survey, 1904, page 63, Case has copied Cope's descriptions. Case has also described and figured (op. cit., p. 64, plate xxvi, fig. 5) the proximal portion of a scapula which he refers to an unnamed species of *Chelone*. This, as well as Cope's specimens, was found in the Calvert formation of the Miocene. These remains are not generically determinable.

Chelonia? parvitecta Cope.

Plate 32, fig. 3.

Chelone parvitecta, Cope, Ext. Batrach., Reptilia, Aves N. A., 1870, p. 155.
Chelone parviscutum, Cope, Cook's Geol. New Jersey, 1868 (1869), p. 738.
Chelone parviscutatus, Cope, Amer. Jour. Sci. (2), 1, 1870, p. 138.
Puppigerus? parviscutum, Cope, Ext. Batrach., Reptilia, Aves N. A., 1870, p. 235, 244.
Puppigerus parvitecta, Cope, Proc. Acad. Nat. Sci., 1872, p. 15.
Puppigerus parvitectus, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 443.

The present species, whose specific name has been so greatly abused, has as its type a single costal plate, which is now in the American Museum of Natural History and bears the number 1318. It was found at Squankum, Monmouth County, New Jersey, and was supposed by Cope to have come from the Miocene marl; but this is Lower Eocene. He reported having found another costal in Charles County, Maryland.

The costal here described (plate 32, fig. 3) appears to have been the sixth of the right side, and to have belonged to an individual whose carapace had a length of about 400 mm. The length of the bone, from the neural border to the distal end, is 125 mm. The width at the middle of the length is 44 mm. The thickness at the sutural border is 5 mm. The rib adds about 3 mm. through the middle of the width. The distal end of the bone is cut off obliquely and the margin is smooth, showing that there were costo-peripheral fontanels and no suture with the peripheral.

On the proximal end of the upper surface appears a portion of a vertebral scute, probably the fourth. The outer angle is distant 45 mm. from the neural border and the angle is less than 90°. The sulcus between the third and the fourth costal scutes runs on the bone near the posterior border.

The upper surface of the bone is markt by numerous vascular grooves. In general, these run toward the distal end, branching and anastamosing. When followed toward the proximal end they soon enter the bone. In the area of the vertebral scute the surface is pitted by vascular openings. The anterior border of the bone is grooved somewhat at right angles with the sutural edge.

Family CHELYDRIDÆ Agassiz.

Plastron loosely joined to the carapace; consisting of nine elements and considerably reduced. The entoplastron T-shaped; the bridge narrow. Nuchal bone with long costiform processes. A full series of neurals. Skull with temporal region incompletely rooft over; the postfrontal bones large. Quadrate notcht for passage of the stapedial rod. Crushing-surfaces without ridges and processes. Caudal vertebræ mostly opisthocœlous.

At the present day this family is represented by 3 genera, *Chelydra* and *Macrochelys* of North America and *Devisia* of New Guinea. The first contains two species; *Macrochelys* and *Devisia* only one each. *Chelydra serpentina* is the best-known species and ranges east of the Rocky Mountains from Canada to Ecuador.

The members of this family are regarded as being among the most primitive of the living turtles. Nevertheless, known remains of the family have not been found in deposits earlier than the Upper Oligocene. *Chelydra murchisoni* is found in the Upper Miocene of Switzerland and *C. decheni* in the Upper Oligocene of the Rhine region, near Bonn.

While the Chelydridæ are in many respects primitive in their structure, in other respects they have deviated considerably from their Amphichelydian ancestors. The roof of the temporal region has suffered considerable reduction. The plastron has undergone reduction. The writer can not believe that the opisthocœlous caudal vertebræ are primitive. The costiform processes of the nuchal are a late acquisition.

As the writer has stated elsewhere, he holds that the Chelydridæ are related to the Cheloniidæ through some Cretaceous ancestor of *Toxochelys*. Altho he has indicated (Bull. Amer. Mus. Nat. Hist., XXI, 1905, p. 167) that the Emydidæ and the Testudinidæ sprang from the Chelydridæ he is now inclined to hold that they had their origin from the Dermatemydidæ.

Genus ACHERONTEMYS Hay.

A genus of Chelydridæ. Carapace broad, considerably deprest. Neural bones eight, about as broad as long, mostly hexagonal, with the broader end forward. A single broad suprapygal. Peripherals, 11 pairs, placed opposite the ends of their respective costals. Vertebral scutes very broad.

Type: *Acherontemys heckmani* Hay.

The relationships of the present genus are yet somewhat uncertain, but they are believed to be with the Chelydridæ. A comparison of the plan of the carapace of the species described below with those of the carapaces of *Chelydra* and *Macrochelys* (Boulenger's Cat. Chelonians, pp. 22, 24) will show that there are great resemblances. The nuchal bone has not the backward extension seen in the Emydidæ. The peripherals do not alternate with the costals. *Acherontemys* differs from the living genera mentioned in having the costals more closely articulated with the peripherals and in possessing extremely broad vertebral scutes.

Acherontemys heckmani Hay.

Fig. 281.

Acherontemys heckmani, Hay, Proc. U. S. Nat. Mus. xxii, 1899, p. 23, plate vi; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 446.

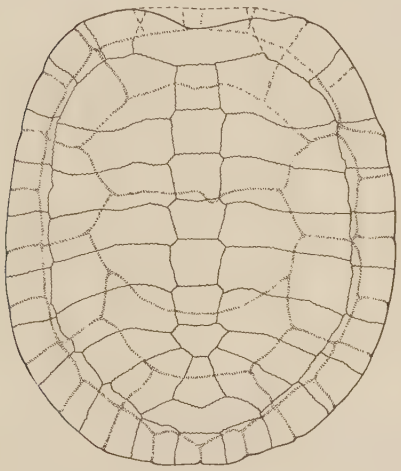


Fig. 281.—*Acherontemys heckmani*. Carapace of type. ×½.

The type of the present species belongs to the U. S. National Museum. It was found near Roslyn, State of Washington, in what is known as the Roslyn sandstone, of the Miocene formation.

The carapace (figure 281) is broad and must have been rather deprest. There are no evidences of serrations on the hinder border of the carapace. The length is 181 mm.; the width, 118 mm. The median line appears to have a sort of keel, with low bosses. The sutures between the bones are distinct. There are 8 neurals. The first is nearly square; the eighth pentagonal and elongated; the others hexagonal. The nuchal is about twice as wide as long. The peripherals are nearly square, and those at the sides are placed opposite the ends of their respective costals.

The sulci are distinctly imprest. The region of the nuchal scute is damaged. The vertebrals are extremely broad. The first has a width of 75 mm.; the second, 90 mm.; the third, 85 mm.; the fourth, 75 mm.; the fifth, 65 mm. The costal scutes are correspondingly diminisht in transverse extent. The first, fourth, and fifth vertebrals are short. In the case of the fourth this is caused by the crossing of the sulcus between it and the third on the sixth, instead of on the fifth neural.

Nothing is known regarding the plastron of this species.

Genus MACROCHELYS Gray.

Three or four additional, or supramarginal, scutes on each side. Orbits lateral. Tail with small scales inferiorly (Boulenger).

Type: *Macrochelys temmincki* (Troost).

This genus is represented in the living fauna by the alligator snapper, a magnificent turtle that lives in the lower Mississippi River region. It reaches a large size and has a disproportionately large head.

Macrochelys floridana sp. nov.

Figs. 282–285.

Macrochelys floridana, Hay, Bull. Amer. Mus. Nat. Hist. xxiii, 1907, p. 847, figs. 1–4.

Four peripheral bones of perhaps as many individuals, a portion of the Jarman collection in Vanderbilt University, indicate a hitherto undescribed species of alligator snapper. It was found in what are probably Peace Creek beds, Hillsboro County, Florida.

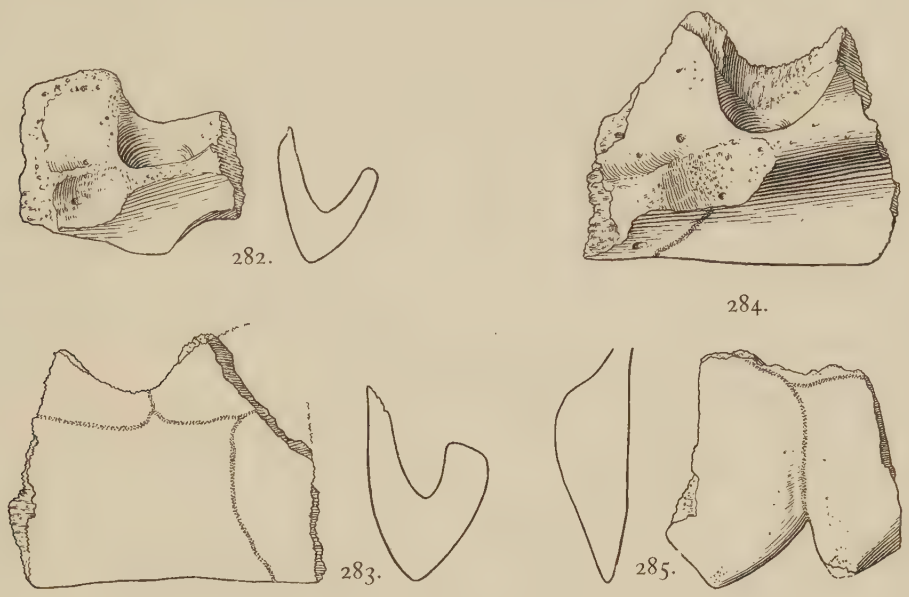
A fourth left peripheral (fig. 282) is 46 mm. long, 34 mm. high, and 21 mm. thick. The upper and lower faces are of moderate convexity and meet in a subacute free border. At the hinder end of the bone is an excavation for a process of the hyoplastron, occupying nearly half the length of the bone.

The right seventh peripheral (figs. 283, 284) is 60 mm. long, 50 mm. high, and 25 mm. thick. The upper border was articulated to the costal by a jagged suture. The slightly convex upper and lower faces meet to form an acute free border. As in *M. temmincki*, there is a long excavation for the hypoplastron.

The ninth peripheral (fig. 285) has in the free border a notch and is tootht both in front and behind this notch. In *M. temmincki* there is a single tooth, the one in front of the notch.

This species differs from the living *M. temmincki* in having the free border of the fourth peripheral far less acute, the upper face more convex, the rib-pit nearer the hinder end of the

bone, and no excavation for the hyoplastron; also in having the free border of the seventh peripheral much more obtuse and the upper border not in sutural contact with the costal; further, in having a single process on the free border of the ninth peripheral.



FIGS. 282–285.—*Macrochelys floridana*. Peripherals of type. $\times\frac{2}{3}$.

282. Fourth left peripheral, with section across middle of length.
283. Seventh right peripheral seen from above, with section across middle of length.
284. Seventh right peripheral seen from below.
285. Ninth right peripheral seen from above, with section near hinder end.

Genus CHELYDRA Schweigger.

No supramarginal scutes. Orbit directed outward and upward. Tail with large scutes inferiorly (Boulenger).

This genus is represented in North America, in a fossil state, only by the following species. Cope's *Chelydra crassa* will be described under the genus *Hoplochelys*.

Chelydra serpentina Linnæus.

Testudo serpentina, LINNÆUS, Syst. Nat., ed. x, 1858, p. 199.
Chelydra serpentina, SCHWEIGGER, Prod., 1814, p. 23.—BOULENGER, Cat. Chelonians, 1889, p. 20, figs. 3, 4.

Cope (Extinct Batrachia, Reptilia and Aves of North America 1869, p. 125) reports briefly that Samuel R. Harrison, of Easton, Maryland, had found remains of this species in Pleistocene deposits at Oxford Neck, Talbot County, Maryland. They were accompanied by bones of *Elephas americanus*, *Cervus canadensis*, *Cariacus virginianius*, and *Terrapene eurypygia*.

Family DERMATEMYDIDÆ Gray.

Plastron in most cases suturally articulated to the carapace; with an entoplastron, but without mesoplastra; the anterior and posterior lobes usually reduced in size. Nuchal bone with or without costiform processes. Neural bones reduced in number, except in *Baptemys;* some of the hinder costal bones meeting their fellows in the midline, except in the same genus. Peripheral bones in 10 or 11 pairs. Plastron furnisht with a full series of inframarginal scutes, except in *Basilemys*. The scutes of the anterior lobe perhaps in all cases modified from the condition seen in *Baëna*. Caudal vertebræ in all the known forms procœlous. The hinder lobe of the plastron often with a scar for the pelvis, but the latter never suturally joined to the plastron. Temporal region not rooft over and no parieto-squamosal arch. Quadrate notcht behind for the stapedial rod.

So far as the writer can determine, there is no good reason for separating the fossil genera that have been arranged under the name *Adocidæ* from the living dermatemyds. The name *Dermatemydæ* was employed by Gray in 1870, apparently a short time before Cope proposed the name *Adocidæ*, and ought, under the form *Dermatemydidæ*, to be used for the family.

It is difficult to frame a definition of the family. Our knowledge of the few living forms is not complete. Of the great mass of the fossil genera we are acquainted with little more than the shells, and often with only small portions of these. Of no fossil genus have we the skull, except that of *Baptemys*. The limbs and feet and the caudal vertebræ are unknown. In the shells there is a great variety of structure. Perhaps no other family furnishes so many deviations from what is regarded as the normal condition in turtles.

Usually in the members of this family some of the hinder neurals are aborted, a condition that permits one or more pairs of the hinder costals to meet their fellows in the midline. In *Baptemys*, however, there is a full series of neurals. In the living genera, *Staurotypus* and *Claudius*, the nuchal bone has long costiform processes, and the possession of these has been regarded as a characteristic of the family; but these processes are absent in *Dermatemys;* while in *Adocus* and *Xenochelys*, and perhaps others, they are short; in *Anosteira* they are absent. The plastral lobes are in nearly all cases shortened and often narrowed. In the living *Dermatemys* (fig. 286) the lobes are quite well developt. In nearly all forms the plastron is suturally articulated with the carapace; but in living *Claudius* the union is ligamentous. In some of the fossil genera the sutures are coarse, forming a transition from the ligamentous connection to the closely knit sutures. In *Adocus* and *Baptemys* axillary and inguinal buttresses rise to the costals, or nearly so. In probably all genera, except *Basilemys*, there is a series of inframarginal scutes crossing the bridge. In *Xenochelys* and *Staurotypus* the number is reduced to two. In probably all genera there is some deviation in the arrangement of the scutes of the anterior lobe from the arrangement seen in such a primitive turtle as *Baëna*. In *Adocus* and some others, this proceeds no further than the great development of the intergulars, by virtue of which the gulars are greatly reduced and pushed far from each other. If this should in any cases have proceeded to the entire suppression of the gulars, the usurping intergulars would be mistaken for the abolisht scutes. Undoubtedly, in some cases, there has occurred either a coalescence or a suppression of scutes. In *Baptemys wyomingensis* there are only 5 pairs on the plastron, excepting the inframarginals. Two pairs occupy the area covered in *Adocus* by the intergulars, gulars, humerals, and pectorals. The pectorals appear to have advanct so as partly to cover the epiplastrals. Three pairs of scutes ought to be found in front of this; but there is only one pair. In *B. tricarinata*, there are apparently distinct evidences of a sulcus crossing the front of the entoplastron and the middle of each epiplastron. This probably bounds the humerals in front. It seems probable that the area in front of this sulcus is occupied by the intergulars and that the gulars have been extirpated.

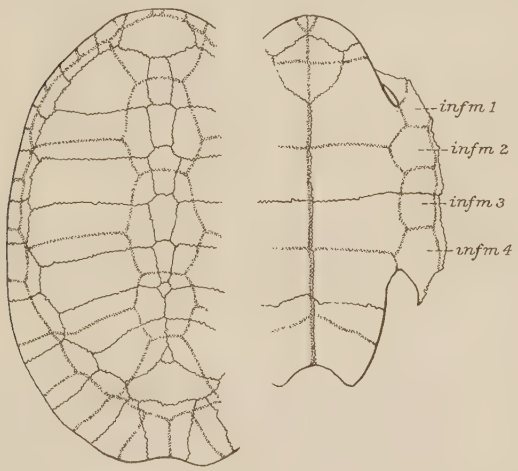


FIG. 286.—*Dermatemys mawi.* Carapace and plastron. After Boulenger.

infm 1, etc., inframarginal scutes.

The plastral scutes of *Agomphus* appear to be arranged like those of *Baptemys*.

In *Xenochelys* we find the modifications of the plastral scutes to have gone still further. On each bridge there are only 2 scutes. What we must regard as the intergulars have coalesct into a single scute. This is followed by a scute on each side which does not come to the midline. The whole area extending from these to the femoral scutes is occupied by a single pair of scutes. The pair of scutes following the intergular may be gulars, but it appears more probable that the pectorals have advanct still further forward than in *Baptemys* and have

crowded the humerals against the intergulars into the place of the supprest gulars. Then the pectorals and the abdominals have coalesct.

In *Anosteira* apparently the plastral scutes were so delicate that they left no impressions of the sulci on the bones.

Usually there are no striking modifications of the scutes of the carapace; but attention may be called to those of *Xenochelys*, and more especially to those of *Anosteira*.

As regards the geological continuance of the family, we find the earliest form, *Basilemys*, in the Judith River beds and three genera exist to-day. All together sixteen genera are here recognized, and these have the geological distribution presented in the accompanying table.

Geological Distribution of the Genera of Dermatemydidæ.

Formations.	Genera.
Recent	Dermatemys, Staurotypus, Claudius.
Pleistocene	
Pliocene	
Miocene	
Oligocene	Xenochelys, Anosteira ?
Eocene	Anosteira, Baptemys, ?Pseudotrionyx, Kallistira, Notomorpha, Alamosemys, Hoplochelys.
Upper Cretaceous	Adocus, Homorophus, Zygoramma, Agomphus, Compsemys, Basilemys.

Pseudotrionyx has been described from the Bruxellian of Belgium by Dr. Louis Dollo. There can be no doubt that it is related to *Anosteira* of America. The Bruxellian beds are equivalents of our Wind River deposits. *Anosteira anglica* has been described from the Lower Oligocene of Hordwell, England. The character of the sculpture and the straightness of the hypoxiphiplastral suture suggest a closer relationship with *Pseudotrionyx* than with *Anosteira*. Like *Anosteira*, *Pseudotrionyx* probably had only 10 pairs of peripherals.

We know nothing about the history of the Dermatemydidæ prior to the Upper Cretaceous. *Tretosternon* Owen, of the Wealden, suggests strongly the genus *Adocus;* but the skull is said by Dollo (*Peltochelys duchastelii*, Bull. Mus. roy. d'hist. nat., Belgique, III, 1884, p. 79) to have the temporal region protected by a bony roof. It is easy to conjecture that some form similar to *Tretosternon* was the Jurassic ancestor of the Dermatemydidæ, which during the Upper Cretaceous times evolved into so many genera and species.

As already stated, *Pseudotrionyx* of the Middle Eocene is evidently related to the Dermatemydidæ. It is believed to be related also to *Carettochelys insculpta*, a species living in the Fly River, New Guinea. Happily, our knowledge of this species has been increast by the description of a better specimen than either of those previously known. This description is given by Mr. Edgar R. Waite in the Records of the Australian Museum, VI, 1905, pp. 110–118, and is illustrated by four plates and three text-figures. Baur regarded this turtle as belonging among the Trionychidæ, but as being closely akin to *Pseudotrionyx* and exhibiting connections with the Dermatemydidæ. Waite shows that the turtle is a true Cryptodiran nearest to the Dermatemydidæ, but also as connecting the Cryptodira with the Trionychidæ. The animal is certainly a Cryptodire, but not a dermatemyd. It belongs to a family near the Dermatemydidæ. Probably *Pseudotrionyx* belonged to the same family; and a comparison of the figures of the shell with those of Dollo's *Peltochelys duchastellii* (Bull. Mus. roy. Hist. Nat., Belgique, III, 1884, p. 78, plate II) shows many striking resemblances. Waite states that the quadrate is not completely closed behind, but that there is a posterior notch, wide but not deeply cleft. On the other hand his figure (op. cit., plate xxvi, fig. 3) appears to show distinctly that the stapes entered the tympanic cavity by a hole in the quadrate, just as it does in *Trionyx*. If this conclusion is correct, this differentiates the family from the Dermatemydidæ; as does also the wide separation of the pterygoids by the palatines and the basisphenoid.

It seems not unreasonable to suppose that from the Dermatemydidæ there sprang the Emydidæ and the Chelydridæ. From the least differentiated Dermatemydidæ, as *Adocus*, the Emydidæ differ especially in the lack of intergulars and inframarginals; but both these series of scutes might cease to be developt. In one of the earliest of the Dermatemydidæ there are no inframarginals, except at the axillary and inguinal notches. Were it not for the intergulars and the extraordinary sculpture of *Basilemys* we might regard it as an Emyd.

KEY TO THE AMERICAN GENERA OF FOSSIL DERMATEMYDIDÆ.

A. Upper Cretaceous genera.
- a^1. No inframarginals, coarsely sculptured with pits, furrows and pyramidal elevations — *Basilemys*
- a^2. Sculpture fine and granular — *Compsemys*
- a^3. Sculpture consisting of shallow pits. Borders of carapace acute-edged. Plastron rounded in front and behind, with full set of plastral scutes. Hinder marginal scutes rising well on the costal bones — *Adocus*
- a^4. Like *Adocus*, but with axillary and inguinal buttresses and costals sending long rib-heads into the peripherals. Bones thin — *Zygoramma*
- a^5. Shell thick and heavy; the free borders of carapace thick and obtuse. Hinder marginal scutes rising little or not at all on the costal bones — *Agomphus*
- a^6. Vertebral scutes said to be usually narrower than the neural bones — *Homorophus*

AA. Tertiary genera.
- a^1. Like *Adocus*, but hinder marginal scutes not rising on costal bones. Torrejon... — *Alamosemys*
- a^2. See *A*. a^5 above. Hinder lobe of plastron pointed. Midway — *Agomphus*
- a^3. Shell thick; free borders acute; three ridges along back; the plastron rather loosely joined to carapace. No inguinal buttresses. Torrejon — *Hoplochelys*
- a^4. Like *Hoplochelys*, but without inguinal buttresses. Wasatch — *Kallistira*
- a^5. Not well known. At least the anterior peripherals obtuse. Wasatch — *Notomorpha*
- a^6. A full set of neurals. Carapace smooth, with a median carina on rear of carapace. Plastron sutured to carapace. Wasatch, Wind River, and Bridger.... — *Baptemys*
- a^7. Shell finely sculptured. Plastron much reduced and loosely joined to the carapace. Bridger — *Anosteira*
- a^8. Shell smooth; no buttresses; five pairs plastral scutes. Oligocene — *Xenochelys*

Genus BASILEMYS Hay.

Shell highly sculptured. Epiplastra much thickened. Bridge wide. Intergular scutes present. Pectorals greatly expanded at the midline, narrowed laterally. An axillary and an inguinal scute but no other inframarginals.

Type: *Compsemys variolosus* Cope.

This genus differs from other known genera of Dermatemydidæ in having no inframarginals, except the axillary and the inguinal.

Basilemys variolosa (Cope).

Plate 32, fig. 4; plate 34, fig. 1; text-fig. 287.

?Compsemys ogmius, COPE, Vert. Cret. Form. West, 1875, pp. 91, 261; Proc. Acad. Nat. Sci. Phila. 1875, p. 9; Brit. N. A. Bound. Surv., Report on Geol. and Resources 1875, p. 336.

Compsemys variolosus, COPE, Proc. Acad. Nat. Sci. Phila. 1876, p. 257; Bull. U. S. Geol. Surv. Terrs., III, 1877, p. 573.

Adocus variolosus, LAMBE, Ottawa Naturalist, XV, 1901, p. 63, plates iii–vi; Cont. Canad. Palæont., II (4to), p. 39, plate ii, text-figs. 4–6.

Basilemys variolosus, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.

Adocus (Basilemys) variolosus, OSBORN, Cont. Canad. Palæont., III (4to), 1902, pp. 12, 16.

Basilemys ogmius, HATCHER, Bull. U. S. Geol. Surv. No. 257, 1905, p. 76.

The type of the present species consists of nearly the whole of the plastron, various peripheral bones, and two imperfect costal plates. These are now in the American Museum of Natural History, and bear the catalog number 1465. This type, with fragments of other individuals, was collected for Professor Cope, in 1876, by Mr. Charles H. Sternberg, in the Judith River beds of Montana. Since that time other specimens of the species have been collected by members of the Geological Survey of Canada, in Judith River deposits, just north of the United States boundary line and east of the Rocky Mountain range. More accurately, the remains were taken on Mackay Creek, along Old Man River, and on Red Deer River.

Fig. 287 is reproduced mostly from Cope's type, but it is probable that the fragment of bone around the axillary notch and the piece of epiplastron do not belong to the same individual as the remainder of the specimen, these anterior pieces being somewhat larger than we

might expect. The diagrammatic figure has been constructed partly from the type and partly from materials belonging to the Canadian Survey.

This species was a large one, and it is distinguisht by a rather remarkable form of ornamentation. The length of the plastron of the type was not far from 670 mm. and the total length of the carapace approximated 775 mm. The form and the elevation probably resembled closely those of the species of *Adocus*. The sculpture seems to be an exaggerated development of that of the genus just mentioned. It resembles considerably that of some species of the Trionychidæ, but the pits are more commonly arranged in rows, and the intervening ridges are more acute. Often where three ridges meet, there is formed a sharp trihedral elevation. The effect is to produce a very rough surface. There are usually about three rows of pits in 10 mm. The whole shell is covered with this sculpture. It is best developt on the upper and lower surfaces of the anterior and posterior peripherals. On the upper halves of the peripherals of the bridge it may be obscure. So also sometimes on parts of the plastron, as in the case of the specimen in the collection of the Canadian Survey.

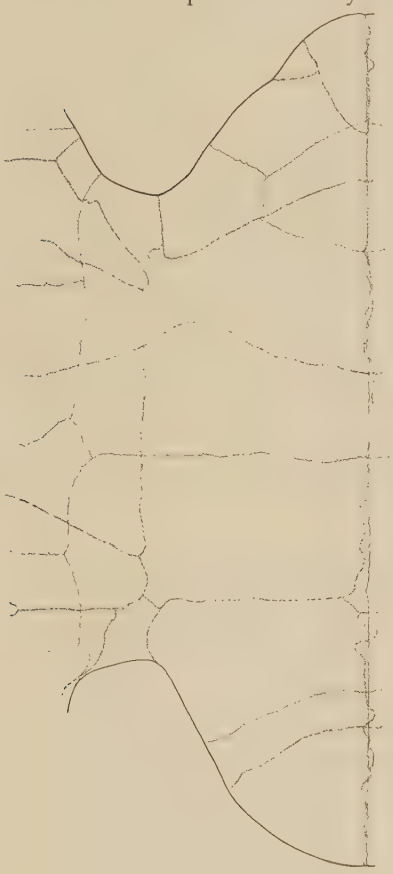


FIG. 287.—*Basilemys variolosa*. Right half of plastron. $\times\frac{1}{6}$. Mostly from No. 1465 A. M. N. H.

The bridge of the plastron is very wide antero-posteriorly, the anterior and posterior lobes relatively short. The rims of the lobes are much thickened, the interior portions considerably thinner. The epiplastron of the Canadian specimen (plate 32, fig. 4), which was about as large as Cope's more complete specimen, is 38 mm. thick near its union with its fellow. This thickness diminishes toward the axillary notch, where it is 28 mm. Behind the entoplastron it is only 15 mm. or even less. The epiplastron of Cope's material has an extreme thickness of 51 mm. The hyoplastral and hypoplastral bones are only 10 mm. thick where they join. At the inguinal notch the rim of the hinder lobe is 40 mm. thick. This gradually diminishes to 12 mm. near the midline behind.

The anterior lobe is about 325 mm. wide and 144 mm. long, measured from a line joining the two axillary notches. Its sides slope forward to a rather blunt point. The lateral face of the thickened rim stands at a right angle with the flat lower surface of this lobe. The sculpture rises on this face and extends for a distance on the upper surface.

The entoplastron is large, being about 160 mm. wide, but only 100 mm. long. It is hexagonal, with the lateral borders shortest.

On the lower surface of the front lobe is found a pair of large intergulars which extend backward to the anterior border of the entoplastron and separate widely the reduced gulars. The humero-pectoral sulcus is at first directed backward from the axillary notch for about 50 mm., then is turned suddenly forward and inward to the middle of the entoplastron.

The posterior lobe is approximately 340 mm. wide and only 160 mm. long. It is broadly rounded behind. On the upper surface of this lobe is a large, smooth scar which marks the point of attachment of the pubis.

The pectoral scutes are narrow at their outer ends. The abdominal scutes are large. The median sulcus pursues a very irregular course from the front to the rear of the plastron.

The bridge is remarkably wide, being about 360 mm., considerably more than one-half of the length of the plastron.

Behind the axillary notch there is a rather short and wide axillary scute, followed by the narrowed lower end of the fourth marginal. The fifth marginal is likewise narrow, but the sixth is greatly expanded. The seventh and eighth are pointed at their lower ends. There is a

single narrow inguinal. We see, therefore, that, excepting the axillary and the inguinal scutes, there were no inframarginals. This conclusion is confirmed by the more complete shell of *Basilemys sinuosa* Riggs.

Of the elements of the carapace the nuchal is unknown and but little is known of the neurals. With the type are parts of 2 costals. One of these appears to be the eighth of the right side. The length of the fragment is 144 mm.; its width was at least 56 mm. At the middle of the width the thickness is 13 mm. The borders and the course of the rib on the inferior surface show that the costal was curved backward from its proximal to its distal end. Not far from its hinder border it is traverst by a deep dermal sulcus. The position of the other costal fragment can not be determined.

Of the peripherals there are present an anterior one, probably the second, the lower halves of most of those forming the bridge on the right side, and those of the right side from the inguinal notch to the pygal. In the collection of the Canadian Survey the third right peripheral is represented by the portion bounding the axillary notch. The greater part of the pygal is with Cope's type. Therefore, with the exception of the nuchal, one anterior peripheral, and the outer halves of the bridge peripherals, we are acquainted with the whole rim of the carapace.

The anterior peripherals did not project so far beyond the soft parts of the animal as did the posterior. The supposed second projected beyond the soft skin of the under side 52 mm. Its length along the free border is 90 mm. The thickness is 21 mm. The portion which articulated with the first costal is missing. The upper surface of the bone is nearly flat; the lower is somewhat convex; the free border is acute.

The third peripheral, as represented by the Canadian specimen, has the thinner portion which articulated with the first costal broken away. The sutural edge which joined the outer anterior angle of the hyoplastron is present. On the anterior end of the outer surface is a right-angled ridge, which farther forward passes into the sharp free border of the carapace. Below this ridge the sculptured surface lookt downward toward the axillary notch; the surface above the ridge was a part of the upper surface of the shell. The whole length of the bone is about 90 mm. and its greatest thickness is 38 mm.

The figure shows what parts of the various bridge peripherals are present. Probably just beyond the line of fracture the peripherals curved upward to join the lower ends of the costals. This outer, or upper, portion of these bridge peripherals appears to be represented by one bone in the Cope collection. The costal margin of this bone was about 18 mm. thick and this border is nearly straight. The length of this peripheral is 103 mm. and it rises at least 110 mm. The sculpture of the outer surface is not so coarse as on most of the bones.

The seventh peripheral (plate 34, fig. 1), the one entering into the inguinal notch, is thick and heavy. Its length is 82 mm.; its thickness anteriorly, 44 mm., posteriorly, 20 mm.; its height, at least 70 mm. Its free border is rounded in the middle of the length, becoming broader and flatter anteriorly, sharper posteriorly. The figure just referred to shows the details of the sculpture. The next four peripherals have respectively the lengths 100 mm., 87 mm., 62 mm., and 53 mm. The heights vary from at least 100 mm. in the eighth to 75 mm. in the eleventh. The upper border of all appears to be broken away, but the suture evidently was near. The eighth, ninth, and tenth have their outer surfaces somewhat concave from above downward, so that these have a slight upward flare. A fragment of the pygal has on it the descending sulcus, thus showing that the bone was about 60 mm. wide. Its free border is acute and the bone is 18 mm. thick, 70 mm. above the free border.

The connection of the costals with some of these posterior peripherals is interesting. It is well shown in an eighth right peripheral in the Canadian collection. This is broken so as to show that the end of the rib beyond the costal plate extends downward into the substance of the peripheral about 30 mm., forming a gomphosial articulation. No such articulation is seen in the bridge peripheral above described.

The greater portion of the pygal is present in the type of the species. It had a length of 60 mm. along the free border and a height of about 75 mm. The outer surface is nearly flat, the inner convex. The free border is acute, as is that of most of the peripherals.

So far as can be determined, the sulci between the costal and the marginal scutes followed pretty closely the sutures between the costal and the peripheral plates. No sulci are found crossing the two costal plates present. On the eighth and ninth peripherals a deeply imprest

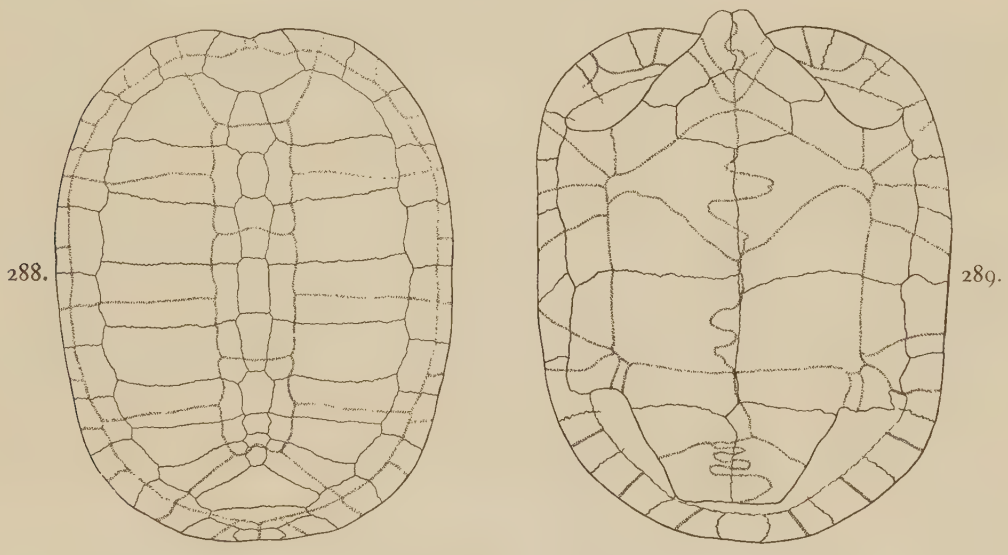
sulcus runs an irregular course across the upper ends, 65 mm. above the free border, then rises and does not appear on the more posterior peripherals and pygal.

Mr. L. M. Lambe, of the Canadian Geological Survey, describes (op. cit., p. 40) some conical, rugose bones which he believes belonged on the tail of this species.

Cope speaks of the dermal sulci as being deeply impressed. This is true of many of them, especially of those of such costals as are known—the anterior plastral sulci, and some others; but many are extremely narrow and shallow, and are difficult to follow as they wander over and among the pits and ridges of the sculpture.

Compsemys ogmius was based on a fragment of what Cope regarded as a costal plate and on a fragment of the plastron. These were never figured. They were obtained in the Judith River beds by Dr. G. M. Dawson, of the British Boundary Survey, at a point along the Milk River, near the boundary between Assiniboia and Alberta. These fragments are now at Ottawa. An examination of the bone identified as part of a costal shows that it is really a part of a bridge peripheral, and that it possibly belongs to *Basilemys variolosa*. The fragment is exceedingly poor. It is only 55 mm. square and shows only a small area of the sculpture, the remainder having been weathered off. Where shown, the ornamentation is obscure. The piece of plastron is 93 mm. long, 35 mm. wide, and 12 mm. thick. The sculpture is nearly effaced by weathering. While these bones may belong to *B. variolosa*, there is too much doubt regarding them to permit us to adopt for them and the last-named species the earlier name *ogmius*. Even if *ogmius* were a species distinct from *variolosus*, it is doubtful whether new materials could be identified by means of the type.

Cope's assignment of the species described above to the genus *Compsemys* is an error. The sculpture of the latter is of a very different character and there were probably inframarginals.



FIGS. 288 AND 289.—*Basilemys sinuosa*. Carapace and plastron. $\times \frac{1}{11}$.

288. Carapace. 289. Plastron.

Basilemys sinuosa Riggs.

Plate 33, figs. 1, 2; text-figs. 288, 289.

Basilemys sinuosus, RIGGS, Pubs. Field Columb. Mus., Geol. ser., II, 1906, p. 249, plates lxxvi, lxxvii.

The fine specimen on which this species is founded was collected by Dr. E. S. Riggs, of Field Natural History Museum, Chicago. It was secured in the Laramie deposits of Chalk Buttes, near Powderville, Custer County, Montana. With it were found bones of *Triceratops*, *Trachodon*, and other characteristic Laramie fossils. The shell is nearly complete. Of the plastron nothing is missing, except some parts of the bridge peripherals. Of the carapace

some portions of the neurals and the contiguous borders of the right third and fourth costal plates are wanting.

The carapace (plate 33; text-fig. 288) is deprest, due probably in some degree to pressure. The anterior border is excavated over the neck, broadly rounded behind. Behind the inguinal notches the borders are somewhat flared upward.

The length of the carapace from the bottom of the notch in front to the rear, measured in a straight line, is 715 mm.; the breadth is very close to 585 mm. The anterior notch is 22 mm. deep. The free border in this notch is about 25 mm. thick. On each side of the midline the border thins rapidly and soon forms an acute edge, which continues to the axillary notch. Behind the inguinal notches the free edges are acute.

The nuchal bone measures 85 mm. along the midline; its width is 145 mm. The first neural was about 80 mm. long and 60 mm. wide behind. The second neural is oval, 68 mm. long, 40 mm. wide. The third is broadest in front, 80 mm. long, 50 mm. wide. The fourth neural is wanting; the fifth is defective. The sixth is 70 mm. long, 50 mm. wide. The seventh and eighth are small and irregular in form. There is a small first suprapygal. The second is bifurcate, as in *Testudo*. It measures along the midline 60 mm.; its lateral extent is 170 mm. The third suprapygal is 72 mm. along the midline and 135 mm. wide. The pygal bone is 52 mm. high and 75 mm. wide. The tenth peripheral bone is 85 mm. along the free border and 102 mm. high. There are 11 pairs of peripherals.

Vertebral.	Length.	Width.
1	100	160
2	145	100
3	165	100
4	125	90
5	140	235

The nuchal scute is small, about 25 mm. long and 15 mm. wide. The first vertebral scute is unsymmetrical. On the left side the anterior border extends 100 mm. from the midline; on the right side apparently only 60 mm. The left appears to be the normal side. The table herewith gives dimensions of the vertebrals.

It will be observed that, with the exception of the first and the last, the vertebrals are considerably longer than wide. The costal scutes are large. The second has a longitudinal extent of 160 mm. and a height of 240 mm. They extend far below the costo-peripheral sutures. Of the marginal scutes there are 12 pairs. The second extends from the free border 42 mm. to the first vertebral scute. The third has a height of 60 mm.; the ninth a height of 60 mm.; the twelfth, a height of 75 mm.

On the lower side of the first and second peripherals the portion covered by the horny scutes is about 50 mm. wide. Toward the nuchal bone and the axillary notch this narrows greatly. Behind the inguinal notches the horn-covered surface on the lower side of the peripherals is about 45 mm. wide to the midline behind.

The plastron (plate 33; text-fig. 289) has a total length of 660 mm. The lobes are short, the bridges wide. The length of the anterior lobe, to a line joining the bottoms of the axillary notches, is 160 mm. The breadth, taken from the inner border of one axillary notch to the other, is 330 mm.

Anteriorly the lobe ends in a beak as prominent as that of many species of *Testudo*. From the anterior end of one gulo-humeral sulcus to the other, the width is 95 mm. The beak extends 42 mm. in front of this. On the lower surface the beak is nearly flat, but toward the front it develops a broad median channel. Laterally the borders of the beak, like those of the whole anterior lobe, are subacute. From this subacute edge the bone rises abruptly and nearly perpendicularly, finally rounding off into the convex upper surface of the beak. The maximum thickness of the bone is 50 mm. On the upper side of the beak the ornamented surface extends back about 55 mm. From the sides of the beak this sculptured surface narrows toward the axillary notch. At the junction of the epiplastron with the hyoplastron the bone is 35 mm. thick. The median portions of the anterior lobe are much thinner.

The entoplastron is short but very wide. Its fore-and-aft extent is 110 mm., the breadth, 145 mm. The form is shown in the figures.

The bridges are about 370 mm. wide. The hinder lobe has a length of 145 mm. and a width of 300 mm. At the borders, for some distance behind the inguinal notches, the bone turns abruptly and perpendicularly upward to the summit of a ridge running backward from the inguinal notch. From the summit of this ridge the bone slopes rapidly downward to the central portion of the lobe. At the hypoxiphiplastral suture the ridge is 50 mm. above the

lower surface of the plastron; at the femoro-anal sulcus, only 20 mm. On the upper surface of each xiphiplastron is a scar for the pubis. This scar is 55 mm. long and 30 mm. wide. The inner borders of the two are 100 mm. apart. The hinder end of the lobe is truncated and bent upward as the hinder extremity is approacht.

The median portion of the plastron is very concave, a condition which appears to indicate that the individual was a male.

On some parts of the plastron the sulci bounding the epidermal scutes are very distinct; in others they are obscure, but determinable. They consist of very narrow, thread-like grooves, some of which pursue their course at the bottoms of broad channels, while others keep on the level of the general surface. The median sulcus runs an extremely irregular course, being first on one side of the midline, then on the other. The intergulars occupy the whole lower surface of the lip, extending backward 100 mm. along the midline. The gulars meet at the midline a distance of 35 mm. Their posterior borders run parallel with the anterior.

At the midline the humerals join for a distance of only 8 mm.; but from this they expand rapidly and their outer ends reach about 60 mm. behind the axillary notch. The pectoral scutes are, fore and aft, extremely broad, meeting along the midline a distance of 195 mm. Their outer ends are only 30 mm. wide. The abdominal scutes extend along the midline 160 mm., while their outer borders are 240 mm. long. The length of the femorals at the midline may be taken as 90 mm.; that of the anals as the same.

The scutes covering the bridge are separated from the plastral scutes just described by a nearly straight sulcus running from the axillary to the inguinal notch. Of these scutes the most anterior and the posterior alone appear to represent the inframarginal series. The others are bridge marginals. Of these, one, the sixth marginal, has become greatly expanded at the abdominal end; the other marginals are greatly narrowed at their lower ends. This absence of a series of inframarginals is remarkable in this family.

The sculpture of this species resembles closely that of its predecessor, *B. variolosa*. The carapace and the plastron are both rough with sharp elevations, which are usually triangular pyramids. These are mostly arranged in rows, of which three or four are spanned by a line 10 mm. long.

The present species differs from *B. variolosa* in various points. The gulars of the Judith River species are crowded far from the median line; in *B. sinuosa* they are in contact with each other. The pectoral scutes of *B. sinuosa* extend backward nearer to the hyohypoplastral suture than they do in *B. variolosa*. The hinder extremity of the plastron of *B. sinuosa* is truncated, bent upward somewhat, and has its borders acute; that of *B. variolosa* is broadly rounded, flat, and the borders are thick and obtuse. From some peripherals present, belonging to the type of *B. variolosa*, it appears that the sculptured, horn-covered surfaces on the under side of the peripherals are considerably broader than they are in *B. sinuosa*. On the eighth peripheral this surface is 70 mm. wide; in *B. sinuosa* it is only 50 mm. wide. The plastron of the type of *B. variolosa* is only about 10 mm. longer than that of *B. sinuosa* Riggs.

A fragment of the epiplastral lip of what is regarded as this species was found by Mr. Barnum Brown of the American Museum, on Hell Creek, Dawson County, Montana.

Basilemys imbricaria (Cope).

Plate 32, figs. 5, 6, 7; text-figs. 290, 291.

Compsemys imbricarius, Cope, Proc. Acad. Nat. Sci. Phila. 1876, p. 257; Bull. U. S. Geol. Surv., III, 1877, p. 573.

Basilemys imbricarius, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.—Hatcher, Bull. U. S. Geol. Surv. No. 257, 1905, p. 77.

Adocus (Basilemys) imbricarius, Osborn, Cont. Canad. Palæont., III (4to), 1902, p. 16.

This species was founded by Professor Cope on very unsatisfactory materials. The type, to which only three fragments (No. 6102 of the American Museum of Natural History) can be referred with any certainty, was found in the Cope collection mingled with fragments of two or three other species. The identified bones are here figured of the natural size (plate 32, figs. 5, 6, 7). All are probably portions of costal plates. The larger piece is traverst by a narrow and sharply imprest sulcus, and appears to be the fragment mentioned by Cope as

having the direction of the ridges of sculpture running at right angles with the sulcus. The inner surface of the bone is removed, so that the thickness of the fragment can not be determined. It was more than 6 mm.

The piece of medium size has a sutural edge along one side. The thickness is 6 mm. where thickest, 5 mm. where thinnest; and it may be the fragment whose measurement Cope gave. The smallest piece of bone is only 3 mm. thick.

This species is distinguisht especially by its sculpture. It is thus described by Cope:

> It consists, in the *Compsemys imbricarius*, of excavations bounded on the sides by a short ridge each, which [excavations] alternate with each other. Thus each bounding ridge terminates abruptly at the fundus of one of the fossæ, while the other end of the fossa rises and contracts into another ridge. The result is precisely that seen in the interior sculpture of Saracenic domes and niches, and is one quite unique among tortoises. The direction of the ridges is at right angles to the costal dermal sutures.

Cope states that three of the fossæ measure in length 6.5 mm. and crosswise, 5 mm. In the case of the largest of the three fragments of the type three fossæ taken together measure 7 mm. and crosswise, 6 mm.

While this style of ornamentation appears to be very peculiar, something scarcely distinguishable in pattern may be seen here and there on the carapace of *B. variolosa*, and for that reason the present species has been referred to *Basilemys*. In fact Cope has labeled as *Compsemys imbricaria* some fragments the sculpture of which appears quite identical with that of *B. variolosa*. With these latter fragments, however, there is what seems to be the thickened rim of the front of the carapace (fig. 290, No. 6100 A. M. N. H.), and this is plainly different from that of *B. variolosa*. Evidently there is another species occurring with *B. variolosa*, related to it, but differing in important characters. For this species we may for the present retain the name *Basilemys imbricaria*.

The remains of this form were collected in 1876, in the Judith River beds of Montana, by Mr. Charles H. Sternberg.

Fig. 290 represents a section across the supposed anterior peripheral, No. 6100 A. M. N. H. The part of this peripheral which joins the costal is missing. On the under side it appears to extend backward to the line reacht by the soft skin, a distance of 27 mm. from the free border. The extreme thickness of the fragment is 16 mm. The upper surface is slightly convex; the lower surface strongly so. The ornamentation is coarse, there being 3 fossæ in 9 mm. This peripheral differs from one in the same region of *B. variolosa* in having the sculptured surface on the under side of the bone much narrower from the free edge to the skin line in proportion to the thickness of the bone.

290. 291.

FIGS. 290 AND 291.—*Basilemys imbricaria.*

Sections. ×⅔. No. 6101 A. M. N. H.
290. Section across peripheral.
291. Section across border of xiphiplastron.

It is to be noted that these coarsely sculptured fragments possibly do not belong to *B. imbricaria*.

In the Cope collection there is another fragment (No. 6101) which possesses a sculpture like that of the specimens just described, and this is evidently a portion of the left xiphiplastron (fig. 291). There are 3 fossæ in 8 mm. It differs from that of *B. variolosa* in having a sharp border separating the lower surface from the surface which looks outward and upward. In *B. variolosa* the lower surface of the hinder lobe rounds gradually into the upper surface.

Professor Cope has labeled as *Compsemys imbricaria* other specimens from the Judith River beds which have a sculpture similar in pattern but much more delicate. In these (No. 6103 A. M. N. H.), some of them fragments of costals, there are 4 fossæ in a line 5 mm. long. The scutal sulci are thread-like. Other fragments, peripherals from the bridge perhaps, have similar ornamentation but the sulci are very broad. It seems very probable that the fragments here described belong to more than one species, but the discovery of additional and much better materials will be required in order to determine the structure and generic position of Cope's *Compsemys imbricaria*.

Genus COMPSEMYS Leidy.

Little-known turtles belonging probably to the Dermatemydidæ. Free surfaces of the bones of carapace and plastron ornamented with small, close-set, enameled tubercles which produce the appearance of shagreen. Neurals hexagonal, with the broader end forward. Costals without distal prolongations into the peripherals. Sulci thread-like. The plastron suturally articulated with the contiguous peripherals and sending up axillary and inguinal buttresses to the costals. No evidences of mesoplastra. Inframarginal scutes probably on the bridges. Vertebral scutes not greatly expanded.

Type: *Compsemys victus* Leidy.

The genus *Compsemys* was establisht in 1856 by Professor Leidy, to receive the scanty remains which he named *Compsemys victus*. Later discoveries have added little to our knowledge regarding the genus; altho it is evident that it is represented over a wide area of territory and thru a considerable range of deposits, having been reported from levels ranging from the Judith River beds to the Denver. The only characterization that Leidy gave to his genus is exprest in the following words:

> The peculiarity of the specimens which has led to the proposal of the genus consists in their exterior surface being closely studded with uniform granular tubercles, which give to them a shagreened appearance, quite different from anything I have had the opportunity of seeing in other turtles.

At a later time Professor Cope assigned to *Compsemys* Leidy's *Emys obscurus* and afterwards returned it to *Emys*. At the same time he referred to *Compsemys* his own *Adocus lineolatus* without explanation. These two species undoubtedly belong elsewhere. The same verdict must be pronounct regarding the three species described by Cope in 1875 and 1876, from the Judith River beds, and called by him *Compsemys ogmius*, *C. imbricurius*, and *C. variolosus*. In 1877 Cope described his *Compsemys plicatula* from the Jurassic of Colorado, and there can be little doubt that his generic reference of the specimen was based on the similarity of the sculpture to Leidy's species. Especially since Dr. Baur's description of Cope's *C. plicatula* it has been regarded as representing the characters of *Compsemys*. However, there can be no doubt that *plicatula* belongs to a wholly different genus from *victa*, and to another superfamily. Most of the references in scientific literature to the genus *Compsemys* (for which see the writer's Bibliography and Catalogue of Fossil Vertebrata N. A., 1902, p. 437) are to the genus as typified by *C. plicatula* and are therefore to be transferred to *Glyptops*. When Baur (Proc. Acad. Nat. Sci. Phila. 1891, p. 412) states that the Laramie forms of *Compsemys* show all the characters of the Jurassic form he seems to have had in mind Cope's *Compsemys variolosa*, but this certainly has no mesoplastron.

So far as at present known the only species to be assigned with any certainty to this genus is the type, *C. victa*. It is probable that when the form that has been reported to occur in the Judith River beds is better known it will prove to be a second species.

Compsemys victa Leidy.

Plate 34, figs. 2, 3; text-figs. 292–295.

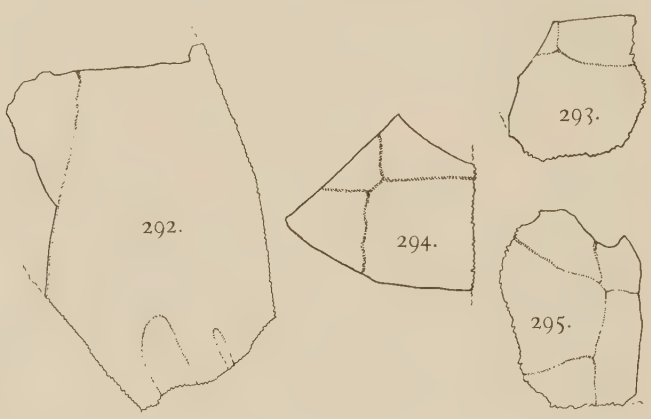
Compsemys victus, LEIDY, Proc. Acad. Nat. Sci. Phila. 1856, p. 312; Trans. Amer. Philos. Soc., XI, 1860, p. 152, plate vi, figs. 5–7.—COPE, Trans. Amer. Philos. Soc., XIV, 1869, p. 124; Seventh Ann. Report U. S. Geol. Surv. Terrs., 1873 (1874), p. 454; Bull. U. S. Geol. Surv., I, No. 2, 1874, p. 30; Vert. Cret. Form. West, 1875, pp. 91, 261, plate vi, figs. 15, 16; ?Brit. N. A. Bound. Comm. Report, 1875, pp. 333, 336; ?Bull. U. S. Geol. Surv., III, 1877, p. 573.—?CROSS, Monogr. U. S. Geol. Surv., XXVII, 1896, p. 227.—?MARSH, Monogr. U. S. Geol. Surv., XXVII, 1897, p. 527.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 437.

Professor Leidy's type of the present species consisted of a neural; a considerable portion of a costal, regarded as a fifth; and a fragment of the eighth costal. These are now in the U. S. National Museum and bear the number 960. They were secured in deposits of probably Laramie age, at Long Lake, North Dakota. The species was afterward reported by Cope from supposed Laramie deposits in Colorado, now regarded as Arapahoe or Denver (Cross, op. cit., pp. 227, 244), and with doubt from Judith River beds (Cope's Fort Union) and from

beds of the same period in the region about Milk River, British America. As the Judith River beds are now known to be much lower in the geological scale than the Laramie it is probable that a distinct species is there included. The Arapahoe and Denver beds being probably above the Laramie, it is not improbable that the remains reported from that horizon by Cope and Marsh belong to a third species of the genus.

Leidy's type indicated a turtle whose carapace had a length of about 365 mm. The neural, regarded as the fourth, was 26 mm. long and 27 mm. wide. The costal plate believed to be the fifth, was 28 mm. wide at the middle of the length. It is rather strongly archt, showing that the shell was not deprest. This costal had a thickness of 7 mm. where it joined the neurals. It is crost at the proximal end by the costo-vertebral sulcus, from which proceeds the sulcus that separated the third and fourth vertebral scutes. The position of the longitudinal sulcus indicates that the vertebrals had a width of about 65 mm. Leidy's estimate that they were 2 inches wide is too small.

The specimens figured by Cope in his Vertebrata of the Cretaceous Formations of the West, plate vi, figs. 15, 16, were collected in 1873, in northeastern Colorado. No statement is made as to the exact locality, but they probably came from the Denver beds in the region about Bijou Creek. We can not be really certain that they belong to Leidy's species. Cope's fig. 16 represents a posterior peripheral, apparently the ninth of the left side, with the sulcus between the third and fourth costals running down its anterior half. The bone is 39 mm. high, 32 mm. wide at the free border, and 9 mm. thick at the costal border. There is no pit for the rib-end. The bone thins to an acute free border. The upper surface is only slightly concave. The sculpture resembles that of the type of the species. A remarkable feature of this bone is the low position of the costo-marginal sulcus. This runs much nearer the free than to the costal border.



FIGS. 292–295.—*Compsemys victa*. Fragments of shell. ×¾.

292. Portion of right costal. No. 6096 A. M. N. H.
293. First right peripheral. No. 1085 A. M. N. H.
294. Fragment of bridge peripheral. No. 998 A. M. N. H.
295. Portion of right hyoplastron. No. 1015 A. M. N. H.

In *Glyptops plicatulus*, as is usual in turtles, it runs nearer the costal border. In the peripheral here described the scute-covered surface on the inferior side of the bone extends to within 15 mm. of the costal border. The granulation is finer than on the upper side of the bone. The other fragment figured by Cope furnishes little additional information.

A right eighth costal, No. 6096 of the American Museum of Natural History, collected by Mr. J. C. Isaac, in 1877, in the Laramie beds, on Lance Creek, Wyoming, was at least 40 mm. wide and from 5 mm. to 8 mm. thick (plate 34, fig. 3; text-fig. 292). The proximal portion and a part of the hinder border are broken away. On the lower surface there is the base of a strongly developt rib-head; but there is no ridge corresponding to the rib, nor any projecting distal end of the rib, such as we find in *Glyptops*. Near the hinder border of the bone is a sulcus, that separating the fourth costal scute from the fifth vertebral. On the peripheral border are two loops of a sulcus, one narrow, the other wider. These appear to have proceeded from the peripheral; but as the peripheral figured by Cope shows the costo-marginal sulci to have run low down on the peripherals, the presence of these loops on the costal is at present inexplicable. Similar irregularly meandering sulci are seen on other bones. The oblique hinder sutural edge of the costal probably articulated with the eleventh peripheral and with the suprapygal. The fourth costal scute may have occupied a portion of the suprapygal, as it does in *Kinosternon*. In the U. S. National Museum there is a neural, the second or fourth, which was collected by Mr. J. B. Hatcher, on Lance Creek, Wyoming.

In 1902, Mr. Barnum Brown, of the American Museum, collected a few fragments of this species in Laramie beds on Hell Creek, Dawson County, Wyoming. One is the first right peripheral (fig. 293). The individual (No. 1085 A. M. N. H.) was a relatively small one. The fore-and-aft extent of the bone is 23 mm., and the thickness of the hinder border, 5 mm. The free edge is acute. The first marginal scute is only 5 mm. antero-posteriorly where it joins the second. The latter widens to 9 mm. at the suture between the first and the second peripherals. On the under side of the bone the sculptured, horn-covered surface is about 7 mm. wide at the suture with the second peripheral, but toward the nuchal it narrows to 3.5 mm.

Of the bridge peripherals there is a portion of one in the American Museum, No. 998, collected by Mr. Brown in 1900, in Laramie deposits of Wyoming, about 40 miles west of Edgemont, South Dakota. This fragment (fig. 294) shows that there was no sharp carina above the bridge, but an obtuse, rounded ridge. Fig. 2, plate 34, represents what is probably the distal end of the fourth costal. Besides the descending sulcus there are again seen some irregular loops coming up from the contiguous peripherals.

Of the plastron there are only fragments known. Fig. 295 represents what appears to be the left outer extremity of the hyoplastron of a young individual from Hell Creek, No. 1015 A. M. N. H. The zigzag sutural border is for articulation with the peripherals, apparently the third, fourth, and fifth. This border is only 2 mm. thick. The longitudinal sulcus is that which passes from the axillary to the inguinal notch. The short branch on the right appears to be the pectoro-abdominal. The three scute areas on the left may be inframarginals or they may be marginals. If inframarginals, they extend wholly beyond the plastral bones. On the inner side of this bone is seen a portion of the strongly developt buttress which rose to the border of a costal, probably the first. It is possible that the bone here described really belongs to the inguinal region. In either case there is indicated the absence of a mesoplastron. On the mesoplastron of *Glyptops* and of *Baëna* there is one inframarginal. There are three on the bone above described. There would thus be seven probably on each bridge.

It will be seen from the descriptions given here of this species that it is very imperfectly known. Additional materials ought to be sought by collectors. Evidently it was a species that attained a considerable size and which, when grown, possest a thick shell. Its sculptured upper and lower surfaces must have rendered it a beautiful animal.

Compsemys? obscura (Leidy).

Plate 34, fig. 4.

Emys obscurus, Leidy, Proc. Acad. Nat. Sci. Phila. 1856, p. 312; Trans. Amer. Philos. Soc., xi, 1860, p. 153, plate xi, fig. 4.—Cope, Bull. U. S. Geol. and Geog. Surv. Terrs., iii, 1877, p. 573.

Compsemys obscurus, Cope, Trans. Amer. Philos. Soc., 1869, xiv, p. 124; Bull. U. S. Geol. and Geog. Surv. Terrs, i, No. 2, 1874, p. 30; Vert. Cret. Form. West, 1875, p. 261.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 437.

This species is retained here under the genus *Compsemys* because it has already been placed there by Cope and Leidy and because we do not know where else to place it. There is little evidence that it is closely related to *Compsemys victa* and there is no probability that it is an *Emys*, in the modern acceptation of that term.

Leidy's type of his *Emys obscurus* was found by Dr. F. V. Hayden at Long Lake, in the present state of North Dakota, in deposits that are now regarded as belonging to the Laramie. The writer does not know where the type is to be found. The part figured and described by Leidy is a portion of a costal plate, extending from the costo-vertebral sulcus to the costo-peripheral suture. This costal is 33 mm. wide, 60 mm. long from the sulcus to the distal end, and little more than 3 mm. thick. The surface is described by Leidy as being smooth. His figure shows that the sutural borders were markt by fine striations at right angles to the sutures.

In the American Museum of Natural History there are the proximal ends of 2 costals which were found by Mr. Barnum Brown, in 1902, in Laramie deposits, on Hell Creek, Dawson County, Montana. These are identified as belonging to the species here described. One of these fragments (plate 34, fig. 4) appears to belong to the second left costal. It is 31

mm. wide, 6 mm. thick at the articulation with the neural, and 3 mm. at the sutural border, just beyond the costo-vertebral sulcus. The proximal end is occupied by one of the vertebral scutes. Near the posterior border of the bone the scute overlapt the bone about 20 mm. The sulci are rather narrow. A broad band of fine striations borders the sutures, the striations being at right angles with the latter. The remainder of the surface is markt by delicate ridges and pits appreciable only under a lens.

The other fragment mentioned belonged to the third or the fifth costal of one side or the other; and it bears a portion of the sulcus between two vertebral scutes. This sulcus extends along the bone a distance of 27 mm. without joining the costo-vertebral sulcus; so that we may conclude that the hinder vertebral scutes were somewhat wider than the anterior.

This species is included by Cope in his list of Judith River fossils, but the writer knows of no specimens that confirm the statement.

Genus ADOCUS Cope.

Carapace firmly articulated to plastron by sutures between the bridge peripherals and the hyoplastrals and hypoplastrals, and by axillary and inguinal buttresses. Heads of ribs, except that of first costal bone, vestigial. Free borders of the peripherals acute. Scutes of the carapace normal; most of the marginals rising and overlapping the lower ends of the costal bones. Lobes of the plastron somewhat reduced; the hinder not notcht. Plastral scutes 7 pairs; the intergulars excluding the gulars from contact on the midline. Inframarginals present.

Type: *Emys beatus* Leidy.

The genus *Adocus*, as here defined, is at present known only from Upper Cretaceous species; and, except *A. lineolatus*, doubtfully referred to the genus, all are from the Upper Cretaceous greensand of the eastern United States. *Adocus* may be regarded as the least modified of the Dermatemydidæ. Its advanct characters appear to be found in the slightly reduced number of neurals, one or two of the most posterior probably being usually missing; in the developt buttresses; in the aborted rib-heads; and in the reduced gular scutes. Primitive characters are found in the possession of seven pairs of plastral scutes and the uninterrupted series of inframarginals.

The following key may be of some value in separating the species:

Key to Species of Adocus.

A. Species of the Rocky mountain region; not well known ..... *lineolatus*
AA. Species of eastern United States region.
  a. Hinder lobe of plastron narrowed behind.
    b. Entoplastron wide; nearly equal to length of the suture between the hyoplastrals *beatus*
    bb. Entoplastron narrow; width nearly twice in the hyoplastral suture ..... *pravus*
  aa. Hinder lobe broad behind; rounded or truncated.
    c. Gulo-humeral sulcus close to or crossing the entoplastron.
      d. Hinder lobe truncated behind; the length between three-fifths and four-fifths the width at the base ..... *punctatus*
      dd. Hinder lobe broadly rounded; its length three-fifths the width at the base; gulo-humeral sulcus just in contact with the entoplastron.. *syntheticus*
      ddd. Hinder lobe broadly rounded; its length four-fifths the width at base; gulo-humeral sulcus well forward on entoplastron ..... *lacer*
    cc. Gulo-humeral sulcus falling considerably behind the entoplastron ..... *agilis*

Adocus punctatus Marsh.

Plate 34, figs. 6, 7; plate 35, figs. 1, 2; text-figs. 296–298.

Adocus punctatus, Marsh, Amer. Jour. Sci. (3), xl, 1890, p. 178, plate vii, fig. 3.—Wieland, Amer. Jour. Sci. (4), xvii, 1904, p. 112, plates i–iv, text-figs. 1, 2.
Adocus beatus, Baur, Proc. Acad. Nat. Sci., 1891, p. 428.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

At the present time this species is represented by better materials than any other of the genus, and for that reason it is here described first of all the species of *Adocus*. The

type belongs to the Marsh collection in Yale University Museum and presents the nearly complete shell. It was obtained in the upper bed of Cretaceous marl at Hornerstown, Monmouth County, New Jersey, in 1872. It has been restored and fully described by Dr. G. R. Wieland, as cited in the synonymy. Dr. Wieland's figures are employed in the present work to illustrate the structure.

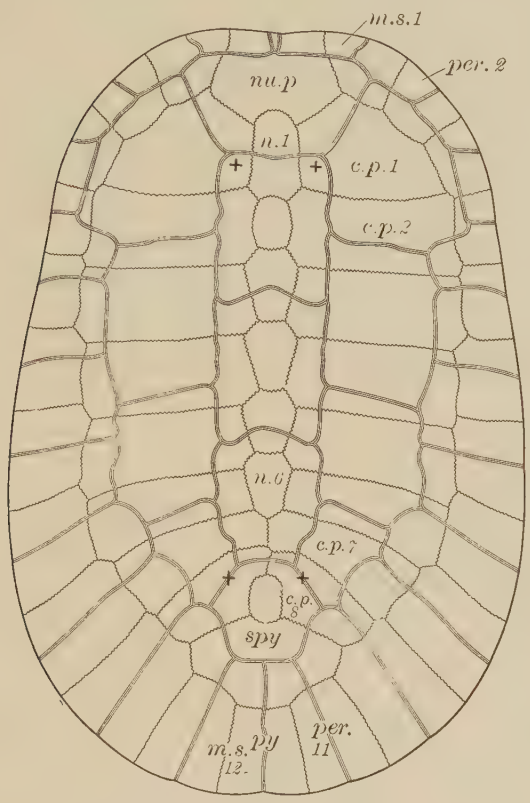


FIG. 296.—*Adocus punctatus*. Carapace of type. ×0.18.

c.p. 1, *c.p.* 2, *c.p.* 8, costal plates; *m.s.* 1, *m.s.* 12, marginal scutes; *nu.p*, nuchal plate; *per*, 2, *per*, 11, peripheral bones; *py*, pygal; *spy*, suprapygal; *n.* 1, *n.* 6, neural bones.

The total length of the carapace (plate 35, fig. 1; text-fig. 296) in a straight line is 533 mm. The greatest width is 390 mm. The form is that of an elongated oval, broadest behind the middle, rounded in front, more broadly rounded behind. Dr. Wieland has called attention to a double curvature along the sides. Possibly this is due to slight distortion. From side to side anteriorly the carapace is quite evenly convex; posteriorly in the restoration it is somewhat flattened. The hinder peripherals are flared somewhat upward, but the front ones are not. The peripherals of the free borders are thin and reduced to an acute edge. In front of the axillary notch the edges of the peripherals are somewhat reverted, leaving a groove within the edges. The nuchal bone is 70 mm. long on the midline; 65 mm. wide on the free edge; 95 mm. where widest. There were 7 neurals, of which all are present except the sixth. Its form and dimensions are determinable from the surrounding bones. The seventh was not developt; the eighth is small. The table below presents the dimensions of the neurals.

Most of the neurals are hexagonal, with the broader end forward. The first has the broader end behind; the second is octagonal. The absence of the seventh neural permitted the seventh pair of costals to meet in the midline. Those of the eighth pair also meet in the midline in front of the eighth neural. The single suprapygal is octagonal, 70 mm. long and 110 mm. wide.

The peripherals are in general large. Their height, at right angles with the free border, increases from the third to the ninth; the tenth has nearly the height of the ninth; the eleventh is considerably smaller. The first peripheral extends along the free border 63 mm.; and from this to the first costal, 65 mm. The second is slightly smaller in both dimensions. The third occupies 50 mm. of the free border and is 65 mm. high. The ninth is 75 mm. along the free edge and 103 mm. high. The eleventh occupies 62 mm. of the free border and rises toward the suprapygal 70 mm. The pygal measures 65 mm. along the free edge and is 60 mm. high.

Neural.	Length.	Width.
1	70	38
2	39	27
3	52	40
4	47	37
5	41	38
6	44	35
7	..	..
8	40	24

The sulci are usually rather narrow and shallow. Those on the front are somewhat deeper and broader. The table on page 238 gives the dimensions of the vertebral scutes.

The costal and the marginal scutes are of unusual conformation. The anterior marginals are mostly small; the lateral and posterior remarkably large. As a result, most of the costals are considerably reduced in area. The nuchal scute is 16 mm. long and only 6 mm. wide. From this the marginals continue to rise slowly above the free border to the hinder end of fourth, which

has a height of 45 mm. All of these lie wholly on the peripherals. The fifth marginal suddenly rises to a height of 100 mm. and overlaps the lower ends of the second and third costal bones. The ninth marginal has a height of 145 mm. The next two are only slightly lower. The supracaudal scutes meet along the midline a distance of 97 mm. The costal scutes diminish in size from the first to the last. The latter has a fore-and-aft length of 80 mm. and a width of 55 mm.

Vertebral.	Length.	Width.
1	100	140
2	95	90
3	100	85
4	98	80
5	80	80

The plastron (plate 35, fig. 2; text-fig. 297), as in other species of the genus, is relatively small. Both the anterior and the posterior lobes are truncated. The total length is 355 mm. The anterior lobe has a length of 80 mm. and a width of 175 mm. at the base. The truncated anterior end is 85 mm. wide. The entoplastron is 50 mm. long and 70 mm. wide. The bridges are 140 mm. wide. The posterior lobe is 130 mm. long and 175 mm. wide at the base. The posterior truncated end is about 80 mm. wide. The free borders of both lobes are acute. The plastron articulates with the peripherals by means of sutures; and axillary and inguinal buttresses rise nearly to the

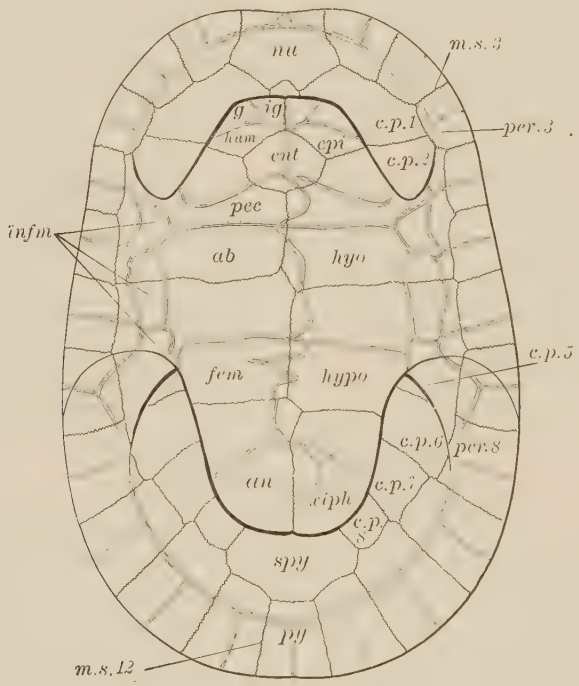


FIG. 297.—*Adocus punctatus*. Lower side of shell. ×0.16.

ab, abdominal scute; *an*, anal scute; *c. p.* 1, *c. p.* 2, etc., costal plates; *ent*, entoplastron; *epi*, epiplastron; *fem*, femoral scute; *g*, gular scute; *hum*, humeral scute; *hyo*, hyoplastron; *hypo*, hypoplastron; *ig*, intergular scute; *infm*, inframarginal scutes; *nu*, nuchal bone; *pec*, pectoral scute; *per.* 3, *per.* 8, peripheral bones; *py*, pygal; *spy*, suprapygal; *xiph*, xiphiplastron.

lower ends of the costal bones. Plate 34, fig. 5, from a drawing made for Dr. Baur, represents the upper side of the xiphiplastral bones. There are very distinct curved depressions for the pubic bones, but there was no sutural articulation of the latter bones with the plastron.

The sutures between the various bones of the plastron are somewhat irregular, as is shown in the figures. The sulci are still more irregular, especially the longitudinal median. All the sulci are narrow and shallow. The intergulars have pushed the gulars away from contact at the midline, and neither gulars nor intergulars overlap the entoplastron. The humerals occupy 42 mm. of the midline. The pectorals measure 40 mm. along the midline and they overlap the hinder end of the entoplastron. The abdominals, the femorals, and the anals respectively occupy 88 mm., 82 mm., and 72 mm. of the midline. There are 3 inframarginals on each of the bridges.

Both the carapace and the plastron of this species are ornamented with rows of shallow pits. On the carapace these pits are arranged mostly in rows that run obliquely across the costal, neural, and peripheral bones. On the median parts of the plastron the pits are less distinct, but still evidently present.

FIG. 298.—*Adocus punctatus*. First left peripheral of type. ×½. After Wieland.

The relationships of this species to *A. beatus* are discust under the latter species. Figs. 298 and 299, taken from Dr. Wieland, represent the position of the sulci on the first left peripheral of *A. punctatus* and *A. beatus*. From these it appears that the width of the first vertebral scutes was considerably greater in the former than in Leidy's species; also that the free border of the bone itself was wider in Marsh's species than in Leidy's. As regards the width of the front of the vertebral scute, there is liable to be variation in it, and not much stress can be placed on it. The specimen in the Philadelphia Academy which the writer is obliged to refer to *A. lacer* differs from the type in the arrangement of the scutes on the first peripheral.

Adocus beatus (Leidy).

Plate 34, figs. 6, 7; text-figs. 299–301.

Emys beatus, LEIDY, Cret. Reptiles, U.S., in Smithson. Cont. Knowl., XIV, 1865, pp. 107, 119, plate xviii, figs. 1–3.

Adocus beatus, COPE, Proc. Acad. Nat. Sci. Phila. 1868, p. 235; Cook's Geol. New Jersey, 1868 (1869), p. 734; Ext. Batrach., Reptilia, Aves N. A., 1869, pp. 129, 233; Proc. Amer. Philos. Soc., XI, 1870, pp. 296, 547; Ibid XII, 1871, p. 43; Vert. Cret. Form. West, 1875, p. 262.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

The type of the present species consists of the anterior half of the first neural, the third and fourth neurals complete, the proximal portions of the second and third costals, the proximal end of the left first costal, and the left first peripheral. These were obtained in the Cretaceous greensand at Mullica Hill, Gloucester County, New Jersey, and were presented to the Academy of Natural Science of Philadelphia, by William M. Gabb. These remains are yet in the Academy's collection.

In 1869 Professor Cope, as cited, identified as belonging to this species a plastron and some portions of the carapace which had been found in the greensand at Medford, New Jersey. These bones are now in the Cope collection at the American Museum of Natural History, at New York. A figure of this plastron is here presented (plate 34, fig. 6). Besides the greater part of the plastron there are present fragments of several costals, and some anterior peripherals.

In 1890 Professor O. C. Marsh (Amer. Jour. Sci., XL, p. 178) described *A. punctatus*. Afterwards Dr. Baur (Proc. Acad. Nat. Sci. Phila. 1891, p. 428) affirmed that this species is identical with Leidy's *A. beatus*. Now, a comparison of Cope's specimen with the type of *A. punctatus* shows that they are without doubt of different species. At the same time, it is perhaps impossible to point out characters which will enable us to separate either Cope's or Marsh's specimens from Leidy's imperfect type. In such a case we must do one of three things—reject Leidy's species and its name, because of its ambiguous characters, giving a new name to Cope's specimen and retaining Marsh's specific name; accept Baur's conclusion, reducing Marsh's name to synonymy and renaming the Cope specimen; or accept Cope's determination and thereby avoid any new names. Cope's turtle having come from the same region and level, and having been first determined as *A. beatus*, it appears to the writer that the last of the three courses is the best to follow. The principal respect in which the Medford specimen differs from Leidy's type is in the thickness of the first peripheral. In Leidy's specimen (figs. 299, 300) this is only 15 mm. thick, while that of Cope's is 20 mm. This does not, however, decide the question in favor of Baur's position, for the type of *A. punctatus* also has this bone 20 mm. thick. It is not at all improbable that the shell was thicker in some individuals than in others. Fig. 300 represents the same bone of Leidy's type, as the bone appears from below, showing an excavation for a process from the nuchal.

Marsh's type of *A. punctatus* and the Medford turtle have the posterior plastral lobes of the same width. The length of the whole plastron of *A. punctatus* is 353 mm.; that of the Medford specimen about 420 mm. The hinder lobe of the Medford specimen (plate 34, fig. 6) is about 18 mm. longer than that of *A. punctatus*. It is also narrow and ends behind in a blunt point, while that of *A. punctatus* is broad and the extremity is truncated. Plate 34, fig. 7, represents the first peripheral of the right side and a part of the second, while text-fig. 301 represents the first left peripheral, all from the Medford specimen. In this the front of the first vertebral scute extends somewhat beyond the end of the first marginal, while in the type (fig. 299) it does not pass beyond the marginal. We must, however, expect variations in this region, as there are variations in the same region in living turtles. The neurals of Leidy's type have the dimensions given in the table herewith.

Neural.	Length.	Width.	Thickness.
1	71	31	7.3–3.1
2	41?	29?	12
3	50	35	11.5
4	46	33	11.5

The thickness of the second neural is determined from the contiguous border of the costal. The dimensions of the remains of costals are shown in the table herewith.

Costal.	Width.	Thickness.
1	..	6
2	46–50	11.4
3	62	12.5

The anterior neural is irregularly angular in front. The second appears to have had the form of the same bone in the type of *A. punctatus*. The neurals of Leidy's type are narrower than those of *A. punctatus*, but no great stress can be laid on the difference. Only a fragment of the first costal is present. The second costal articulated with the first, second, and third neurals, just as in *A. punctatus*. The first peripheral is 62 mm. antero-posteriorly, about 54 mm. along the free margin, and 15 mm. thick. Fig. 299, from Wieland, shows the form of this bone and the arrangement of the scutes on it. The neurals and costals show the regular and shallow pitting exhibited by *A. punctatus* Marsh.

The plastron of this species is known only from the specimen described by Cope (plate 34, fig. 6). The dimensions may be obtained from the comparative table on page 242. The total

FIGS. 299–301.—*Adocus beatus*. Peripherals. ×½. After Wieland.

299. First left peripheral of type.
300. First left peripheral of type, inferior surface, with section near suture with second peripheral. Shows pit for process of nuchal. Upper surface of section toward right.
301. First left peripheral of Cope's Medford specimen. No. 1138 A. M. N. H.

length may have been greater than that there given, since there is an interval wanting in the hyoplastron, and since less space has been allowed between the hyohypoplastral suture and the inguinal notch than between this suture and the axillary notch. The bridge, as restored, has a width of about 160 mm. The sides of the anterior lobe are only slightly convex; the front broad and truncated, its width being about 95 mm. The anterior border is obtuse in section.

The hinder lobe is gradually reduced in width backward and it ends obtusely. As Cope remarkt, there is some asymmetry near the extremity, but this is individual. The free borders of this lobe are subacute and a shallow groove runs parallel with the border on the upper side of the bones.

The sulci of the plastron are rather obscure. That of the median line has not been represented in the figure. Probably it ran an irregular course, such as is seen in the other species. The intergular scute is large and it trespasses on the margin of the entoplastron, separating

widely the gulars. It was probably divided. The gulars are of rather peculiar form, extending outward and backward toward the outer hinder angle of each epiplastron. The humero-pectoral sulcus is so obscure that its course is uncertain, but it appears to run where indicated in the figure. If this is correct, it did not cross any part of the entoplastron. The pectoro-abdominal sulcus and the abdomino-femoral are distinct and as shown in the figure. The course of the femoro-anal is as represented in the figure. Of the inframarginal series, only a small portion of one axillary scute is seen. The sculpture of the lower surface is hardly to be determined, the result of weathering.

Both first peripherals are present (plate 34, fig. 7; text-fig. 301). The antero-posterior length is 65 mm.; the length along the free border, 64 mm.; along the hinder border, about half as much. The thickness, as stated, is 20 mm. The upper surface of this bone is gently convex; the lower surface is strongly convex antero-posteriorly. Close to the anterior border above there runs a shallow groove, so that the free border appears somewhat everted. On the lower surface the sutural face for articulation with the nuchal is excavated for the short costiform process of the latter. The same excavation appears in the first peripheral of Leidy's type of the species (fig. 300).

The marginal scutes did not extend upward quite half-way on the peripheral. Only a fragment of the second peripheral is present. The form of the nuchal bone can only be inferred from the sutural edges of the adjoining first peripherals. It seems probable that its right and left sides made a sharper angle with each other than they do in *A. punctatus*. It is extremely probable that the front border of the nuchal measured between 65 and 70 mm. The front of the first vertebral scute would then measure about 130 mm.

There are present fragments of various costals and bridge peripherals. The proximal end of a costal, probably the left third, has a width of 50 mm. and a thickness of 11 mm. The sulcus bounding laterally the two vertebral scutes of which it bears parts is distant 25 mm. from the suture made with the neural. These vertebrals were then about 80 mm. wide, much narrower than the first vertebral. The distal end of another costal is 60 mm. wide and 8 mm. thick. It is crost by a sulcus which runs from 17 mm. to 45 mm. above the lower or distal end. A bridge peripheral is represented by the end which joined the costal. It is 57 mm. wide and 6 mm. thick. On its inner surface is a broad, shallow groove for the extremity of the rib, and a portion of the rib extended beyond the border of the costal plate at least 50 mm. Another fragment, which appears to be part of a peripheral near one of the buttresses, indicates that a rib sent its free extremity down deep into the bone forming a gomphosis, as in *Zygoramma*.

The costals and the peripherals are ornamented with shallow pits separated by low, rounded walls, and are arranged somewhat in rows. On the outer ends of the costals and peripherals the sculpture is often obscure.

Adocus lacer sp. nov.

Plate 34, fig. 8; plate 36, fig. 1; text-figs. 302–307.

The type of this species belongs to the Cope collection in the American Museum of Natural History. Its number is 1350. There is no history regarding the origin or the finder of the specimen, but there is no doubt that it was obtained from the upper greensand bed of the Cretaceous of New Jersey. There is nothing to indicate to what species Cope referred it. The materials include the greater portion of the plastron, the nuchal, the three anterior peripherals of both sides and a small portion of the left front costal.

The species is characterized by a plastron (plate 36, fig. 1) which is elongated in proportion to the width of the base of the hinder lobe. The bridge likewise is longer, in relation to the width of the hinder lobe of the plastron, than in any of the other species. In width of bridge, in relation to the length of the plastron from the entoplastron to the rear of the xiphiplastrals, *A. agilis* exceeds it. The hinder lobe resembles most that of the species just named, but the lateral borders are not so uniformly curved and there is on the upper surface a groove parallel with the free edge. The dimensions of the various parts are to be obtained from the table on page 242.

The anterior lobe is not represented in front of the hyoplastron, except by about one-fourth of the entoplastron. The latter has had a width of about 88 mm. The free border of

the hyoplastron in front of the axillary notch is acute, differing thus from *A. agilis* and *A. beatus*. The hyoplastral and the hypoplastral portions of the median suture are nearly equal in extent; whereas in *A. agilis* the hypoplastral portion is considerably longer than the hyoplastral part. The transverse suture between the anterior and posterior halves of the plastron is very coarse, there being alternately large pits and processes for mutual gomphosial articulation. The form and proportions of the hinder lobe may be determined from the table on this page and from the figure. The free borders are acute, with a parallel groove on the upper surface. The scar for the pubis resembles that of the other species, but it is more deeply imprest. Just in front of the hinder border of the xiphiplastrals and lying across the midline there is a conspicuous elevation, the thickness of the bone here being 16 mm. In the center of the lobe the bone thins down to about 10 mm.

The pectoral scutes are of considerably greater extent antero-posteriorly than in *A. agilis*, 68 mm. as opposed to 36 mm., the humero-pectoral sulcus swinging well forward on the entoplastron. The abdominal scutes are larger than those of any of the five species compared with this one in the table, the sulcus between them being 135 mm. long. The femoral scutes also exceed those of the other related species, being 100 mm. in the midline. The anal scutes are relatively short, 75 mm. There are 3 inframarginal scutes on the bridge, the middle one being 107 mm. long and 28 mm. wide. In the figure the sulci are represented as being broader than they really are.

Table of measurements of species of Adocus.

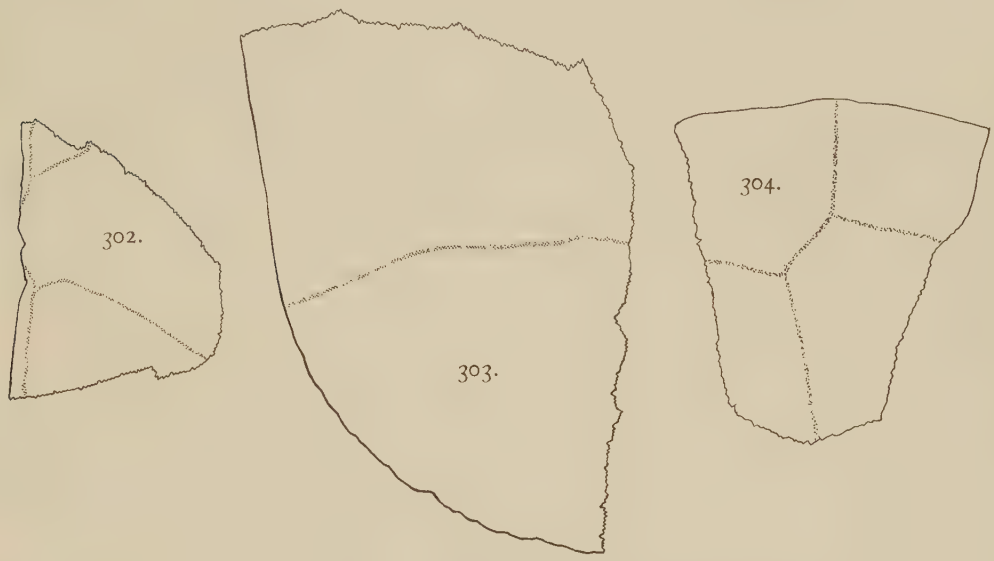
	A. beatus.	*A. agilis.*	*A. syntheticus.*	*A. punctatus.*	*A. lacer.*	*A. pravus.*
Length of plastron	420±	...	454	356	...	450±
From hinder border of entoplastron to rear of plastron	340±	310	346	283	355	...
Hyoplastron on midline	100±	95	R. 85 L. 115	80	125	110
Width of bridge	160	185	200±	144	192	...
Hypoplastron on midline	115	120	R. 147 L. 120	105	120	130
Length of hinder lobe	148	130	145	130	140	...
Length of xiphiplastron	120	100	115	100	115	...
Width of plastron at bridge	...	290	380	280	285	...
Width of anterior lobe at base	160	210±	...	190	...	180
Width of hinder lobe at base	175	177	230	176	177	...
Width of entoplastron	88	91	95	...	88	70
Length of entoplastron	54	69.5	70	...	...	...
Thickness at crossing of median sutures	14	12	16	...	17	12
Thickness of epiplastron at symphysis	15	...	14	...	...	...
Thickness of hyoplastron in front of axillary notch	15	14	14	...	14	...
Thickness at front of xiphiplastron in midline	17	16	18	...	13	...

The plastron is considerably eroded. The lower surface is furnisht with numerous small pits, some of them resembling pin-holes, but to what extent these are due to weathering it is difficult to say.

The anterior rim of the carapace, from one axillary notch to the other, shows that at these notches the carapace had a width of 455 mm. Whether or not the carapace expanded backward, as it does in *A. punctatus*, can not now be decided. The front (plate 34, fig. 8) is almost exactly an arc of a circle whose radius is 197 mm. The front of *A. punctatus* is somewhat truncated. The rim is thick and heavy, except that the nuchal bone is excavated on its hinder surface, so that its thickness is only 14 mm. At its articulation with the first peripherals it has increased to 25 mm. The greatest thickness of the third peripheral, just in front of the axillary notch, is 40 mm.

The upper surface of the nuchal and of the anterior peripherals is slightly convex from above downward. The free edge is rather thin and is somewhat reverted, as in *A. punctatus*. The lower side of the peripherals is very convex from front to back; that of the nuchal concave. The free border of the nuchal measures 75 mm. At its upper, or hinder, border it

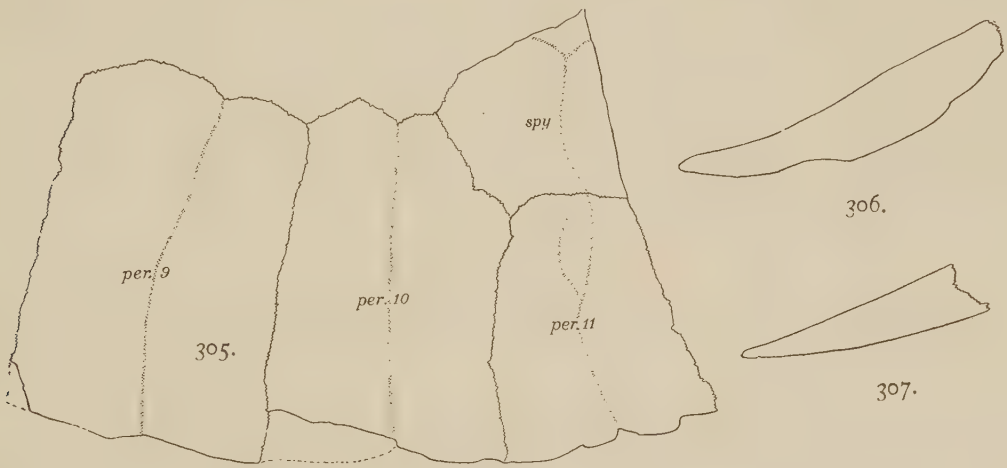
is 92 mm. wide. Its extent front to back is 75 mm. Its hinder border is somewhat excavated for union with the first neural. The free borders of the three anterior peripherals measure each from 60 mm. to 65 mm. The height of the first is 65 mm.; that of the third, 83 mm.



FIGS. 302–304.—*Adocus lacer*. Entoplastron, xiphiplastron, and peripheral. ×⅔.

302. Entoplastron, left half. 303. Right xiphiplastron. 304. First left peripheral.

The sulci separating the marginal scutes from the vertebral and the costals is not far above the free border of the bones. If there were a distinct nuchal scute it has been effaced by a slight injury to the bone. The first marginal is 25 mm. from front to back. The height of the succeeding ones increases until that of the fourth is 40 mm. The first



FIGS. 305–307.—*Adocus lacer*.—Peripherals. ×½.

305. Ninth, tenth, and eleventh peripherals and part of suprapygal.
306. Section near hinder end of ninth peripheral.
307. Section of eleventh peripheral where it joined the pygal.

vertebral scute has a width from side to side of 150 mm. It probably had the form found in *A. punctatus*.

In the collection of the Philadelphia Academy there is a lot of bones of an *Adocus* which is referred to the present species. There are no data accompanying the specimens, but there

can be no doubt that they were found in the Cretaceous greensand of New Jersey. There are present the left first, ninth, tenth, and eleventh peripherals, a part of the suprapygal, some fragments of costal bones, the left half of the entoplastron, the left hypoplastron, and the right xiphiplastron. Fig. 302 represents the piece of the entoplastron. When complete it was 56 mm. long, 80 mm. wide, and 18 mm. thick at the hinder border. The intergular scutes encroacht on the front of it and the pectorals on the hinder border. The hinder lobe was 173 mm. wide at the base and about 135 mm. long. The left hypoplastron is 103 mm. long. At the midline, between the inguinal notches, it is 28 mm. thick. Fig. 303 represents the outline of the right xiphiplastron, seen from below. It agrees in form with that of the type of the species, and shows that the hinder end of the plastron was broadly rounded. At the middle of the suture with the corresponding hypoplastron it is 18 mm. thick. There was, near the outer border, a stout process that fitted into the hypoplastron. On the upper surface is a large depression for the pubic bone. In the midline, at the hinder ends of the xiphiplastra there is a considerable elevation, and here the thickness of the bone is 20 mm.

Both the hypoplastron and the xiphiplastron are pitted, the latter most distinctly. The surface of the entoplastron is irregularly pitted.

Fig. 304 presents a view of the first left peripheral, and this may be compared with that of *A. beatus* and that of *A. punctatus*. It measures 61 mm. along the free border and 68 mm. at right angles to this. Its greatest thickness, where it joins the nuchal, is 20 mm. It will be observed that the arrangement of the sulci differs from that of the type and resembles more that of *A. punctatus*. It is to be concluded that the scutes here were somewhat variable in their development. The free border of the bone is somewhat reverted, as in the type.

The three hinder peripherals are narrow and high (fig. 305). The ninth has a width of 65 mm. and a height of 100 mm.; the tenth a width of 60 mm. and a height of 95 mm.; the eleventh a width of 58 mm. and a height of 68 mm. With the latter peripheral is a portion of the suprapygal. Evidently, as in *A. punctatus*, the costo-marginal sulci ran at some distance above the peripherals. A part of the fifth vertebral scute appears high up on the suprapygal. Figs. 306 and 307 represent the hinder sutural faces of the ninth and eleventh peripherals.

On the upper borders of the ninth and tenth peripherals are seen remains of the extremities of the ribs of the seventh and eighth costals, which extend down into the peripherals. On fragments of the bridge peripherals are seen the rib-ends lying in shallow grooves on the inner surfaces, sometimes extending downward as much as 50 mm. Other fragments of bridge peripherals show that the transition from the upper to the lower surfaces was rather abrupt, there being a decided but rounded angle where the turn was made.

The peripherals and the costals are all ornamented with pits, arranged mostly in oblique rows. There are about 5 pits in a line 6 mm. long.

Adocus syntheticus Cope.

Plate 36, fig. 2.

Adocus syntheticus, COPE, Proc. Amer. Philos. Soc., XI, 1870, p. 515 (name only); Ibid., p. 548; Op. cit., XII, 1871, p. 44; Vert. Cret. Form. West, 1875, p. 262.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

Professor Cope's first reference to this species did not bear with it any description. The species was said to be based on a plastron lacking the entoplastron, the right epiplastron and the right hypoplastron, a peripheral bone from the bridge, 2 imperfect costals, and some smaller fragments. This type is now in the American Museum of Natural History, and has the number 1466. All the parts originally described are present, except the hinder extremity of the right xiphiplastron. The "marginal from the bridge" is a part of the right hypoplastron. The specimen was found in the upper bed of the Cretaceous greensand, at Barnesboro, New Jersey.

Professor Cope states that the length of the plastron is 484 mm. This is probably a misprint for 454 mm., which appears to be nearer to the correct length. The plastron as a whole

is broad and flat. It was truncated in front and broadly rounded behind. With only the known materials it is impossible to state accurately the length and width of the anterior lobe. The anterior, truncated end had a width of about 80 mm. The two epiplastrals joined along the midline for about 37 mm. The anterior free border of the epiplastral is thick, but the lateral border thins down backward to an edge. The size and form of the entoplastron can be judged from the surrounding bones. Cope gives the length as 70 mm. and the width as 95 mm., which dimensions appear to be correct.

As will be seen from the plate 36, fig. 2, the sutures are extremely irregular in their course. The entoplastral notch in the hyoplastrals is not symmetrical. On account of unsymmetrical development, the right hypoplastron articulated with both hyoplastra, the left hypoplastron, and with both xiphiplastra. The right hypoplastron is thus 27 mm. longer than the left. These and other measurements are presented in the table on page 242.

Professor Cope states that the length of the hinder lobe of the plastron is 155 mm.; the width, 230 mm. He also says that a fragment of the bridge displays the axillary and part of the anterior inframarginal scutes; but to the present writer this fragment seems rather to belong to the inguinal region of the right side. The reason for this identification is found in the fact that in *A. punctatus* and *A. lacer* the pectoro-abdominal sulcus starts off from the sulcus bounding the axillary scute on the mesial side, while the abdomino-femoral sulcus does not come into contact with the inguinal scute on the lower side of the plastron. In the fragment under consideration the arrangement of the sulci conforms to that of the region of the inguinal notch. On placing this fragment in this region the hinder lobe is found to have a length of 145 mm. and a width of 230 mm., being unusually short in proportion to the width.

The central portion of the hinder lobe is thick, but the free borders are thin and acute, the thickness becoming gradually reduced. On the upper side of the xiphiplastra there is a prominent curved ridge, and nearer the midline a deep depression. These mark the attachment of the pubic bone. A rounded knob marks the position of the ischium.

The fragment of the bridge which has already been referred to as belonging properly to the inguinal region bears on its upper, or inner, surface a strong ridge which rises to form a buttress against the carapace. The inner border of the buttress is sharp. There is another fragment of the bridge present, the outer end of the right hyoplastral. This does not reach so far forward as the axillary notch; backward it extends to the hyohypoplastral suture.

The sulci of the plastron are mostly very distinct, but not broad nor deeply imprest. The longitudinal median sulcus runs a meandering course, but anteriorly it is too obscure to be traced. There was a large intergular, probably divided. Its width was about 40 mm. Its hinder border encroacht slightly on the entoplastron. The gulars were widely separated by the intergular. The pectorals met along the midline for about 42 mm. and overlapt slightly the entoplastron. The abdominals occupied 135 mm. of the midline; the femorals, about 82 mm.; and the anals, also about 82 mm. The inframarginal scutes were large, the middle one about 135 mm. long and 50 mm. broad. Outside of the inframarginals are portions of 3 marginals, the fifth, sixth, and seventh. The sixth is 137 mm. broad, running along the middle inframarginal for the entire length of the latter.

The surface of the plastron is finely granulated, vermiculated, or pitted, but no definite pattern of sculpture can be made out. On each side of most of the sutures there is a band of fine parallel grooves.

Portions of 2 costals are present, showing the proximal ends. One of these is 55 mm. wide at the proximal end and 8 mm. thick. On the inner surface there is seen the rudimentary rib-head. The other costal, probably the left seventh, is 38 mm. wide proximally, but it widens distally. It is notcht proximally for a neural, probably the sixth, and behind the latter it apparently met the corresponding costal of the opposite side. The surfaces are smooth and present no distinct evidences of sulci.

The form of the plastron of this species is most like that of *A. agilis*, but it differs from that of the latter in being relatively shorter, in having the lateral borders more convergent from the base, and the bone does not thicken so rapidly from the acute free edges. The sculpture of the plastron of *A. syntheticus* is quite different from that of *A. agilis*, and the inframarginal scutes are much broader.

Adocus agilis Cope.

Plate 36, fig. 3.

Adocus agilis, COPE, Proc. Acad. Nat. Sci. Phila. 1868, p. 235; Cook's Geol. New Jersey, 1868 (1869), p. 734; Ext. Batrach., Reptilia, Aves N. A., 1869, pp. ii, 233, 234; Proc. Amer. Philos. Soc., XI, 1870, pp. 296, 297, 549; Op. cit., XII, 1871, p. 44; Vert. Cret. Form. West, 1875, p. 262.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

The type of this species is in the American Museum of Natural History and bears the number 1135. It was collected in the upper bed of the Cretaceous greensand of New Jersey, at Barnesboro.

The only portion of the animal represented is the plastron (plate 36, fig. 3) and this is not complete. Cope states in his description that the extremities of both lobes are broken off; but at present the hinder lobe is complete on the right side. The front of the anterior lobe being gone, the total length of the plastron can not be determined with exactness. Cope estimated it at 450 mm.; but this is certainly an error; it was probably not greater than 400 mm., and more probably about 390 mm.

The plastron is short and broad, but yields in these respects to that of *A. punctatus*. The dimensions may be obtained from the table on page 242. The plastron is very flat, even out to the suture with the peripherals of the bridge, but it is possible that the bridge has been distorted through pressure. The entoplastron has its anterior angle now broken off, but Cope gave its length as 69.5 mm. Its width is 91 mm. The free edge of the hyoplastron, just in front of the axillary notch, is rounded in section. The bridge is, relatively to the length of the plastron behind the entoplastron, longer than in any species with which it is compared on page 242.

From the inguinal notch the free borders of the hinder lobe curve gradually to the midline behind. These borders are acute, and from them the bone thickens rather rapidly and without the intervention of a groove on the upper surface. The center of the lobe has no depression such as we find in *A. lacer* and to a less extent in *A. beatus*. On the hinder half of the upper surface of each xiphiplastron there is a large curved depression which marks the place of articulation of the pubis. It is not so deeply imprest as it is in *A. lacer*.

Cope gave, as one character separating this species from the others then described, the thinness of the bones; but they appear to be only a little thinner than those of *A. beatus*.

The hyoplastron just behind the entoplastron is 13 mm., that of *A. beatus*, 14 mm.; just in front of the axillary notch, 14 mm., that of *A. beatus*, 17 mm.; medially at the front of the xiphiplastron, 16 mm., in *A. beatus*, 17 mm.

The humero-pectoral sulcus falls behind the entoplastron. The abdominal scutes meet along the midline for a distance of 105 mm.; the femorals, 87 mm.; the anals, 76 mm. The inframarginals on the bridge are long and narrow, the middle one being 80 mm. long and 16 mm. broad. The median longitudinal sulcus runs a very irregular course, especially in the hinder half of the plastron.

The whole lower surface of the plastron is ornamented with a sculpture which consists of very shallow, somewhat elongated depressions separated by low rounded walls. The pits alternate somewhat and are arranged more or less in rows. These run usually in a longitudinal direction. The sculpture is much like that of *A. beatus* and *A. punctatus*, and reminds us of Cope's description of that of *Basilemys imbricaria*, but the pits are not nearly so deep as in the latter species.

Adocus pravus Leidy.

Emys pravus, LEIDY, Proc. Acad. Nat. Sci. Phila. 1856, p. 303; Smithson. Contrib. Knowl., XIV., art. vi, 1865, pp. 108, 120, plate xix, fig. 1.

Adocus pravus, COPE, Proc. Acad. Nat. Sci. Phila. 1868, p. 235; Cook's Geol. New Jersey, 1868 (1869), p. 734; Ext. Batrach., Reptilia, Aves N. A., 1870, pp. 129, 233, 234; Proc. Amer. Philos. Soc., XI, 1870, p. 297; Ibid., XII, 1871, p. 44; Vert. Cret. Form. West, 1875, p. 262.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

Emys parva, MAACK, Palæontographica, XVIII, 1869, p. 278.

The present species was discovered by Professor George H. Cook, State Geologist of New Jersey, in the upper bed of Cretaceous greensand at Tinton Falls, Monmouth County, New Jersey, and was described by Dr. Joseph Leidy. Originally the type consisted of most of the

left hyoplastron, a large part of the right hypoplastron, and the hinder ends of both xiphiplastra. Of these, there is now in the collection at Rutgers College only the hyoplastron.

The species is characterized by the thinness of the bones, being approacht in this respect only by *A. agilis*. The hyoplastron has a thickness varying from 10 mm. to 12 mm. According to Leidy the hypoplastron varies in thickness from 10 to 14.5 mm.

From the portion of the hyoplastron present it appears that the width of the anterior lobe at the base was about 180 mm. The hyoplastral bones joined along the midline a distance of about 110 mm. The entoplastron had an approximate width of 65 mm. and extended backward behind the hyoepiplastral sutures about 40 mm. A sulcus, the humero-pectoral, crosses the plastron 7 mm. behind the entoplastron and is directed slightly backward on its way outward. The free border of the lobe is subacute. All the sutures of the hyoplastron appear to have been close and smooth when viewed from below; but, seen from above, they were coarse and jagged.

The hypoplastra are stated by Leidy to have extended along the midline 5 inches; according to his figure, 130 mm. The hinder end of the plastron appears to have been narrowed, as in *A. beatus*.

This species seems to have most resembled *A. agilis;* but the entoplastron of the latter is considerably broader, less abruptly rounded, and the notch was more open. In *A. syntheticus* and *A. punctatus* the humero-pectoral sulcus crosses on the entoplastron.

This species differs from Cope's specimen of *A. beatus*, from Medford, in having a narrower entoplastron. In the latter the width of this bone was about equal to the length of the suture between the right and left hyoplastra. In *A. pravus* the width was equal to only two-thirds the suture between the hyoplastra. In other respects the two species, so far as known, appear to agree. Altho Leidy has restored in outline the anterior lobe of *A. pravus* as being very narrow, it may in reality have been much broader.

Adocus? lineolatus Cope.

Figs. 308, 309.

Adocus? lineolatus, Cope, Bull. U. S. Geol. and Geog. Surv. Terrs., 1, No. 2, 1874, p. 30; Ann. Report U. S. Geol. and Geog. Surv. Terrs., 1873 (1874), p. 454; Vert. Cret. Form. West, 1875, p. 92.—Lambe, Contrib. Canad. Palæont., III (4to), 1902, p. 38.

Adocus lineolatus, Cope, Vert. Cret. Form. West, 1875, p. 263, plate VI, figs. 11, 12.—Hatcher, Bull. U. S. Geol. Surv. No. 257, 1905, p. 75.

Compsemys lineolatus, Cope, Bull. U. S. Geol. and Geog. Surv. Terrs., III, 1877, p. 573.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 437.

Of the present species very little is known. The name is based on 2 fragments which were collected by Professor Cope, in northeastern Colorado. From Whitman Cross (Monogr. U. S. Geol. Surv., XXVII, 1896, p. 244) we learn that Cope communicated the fact that these and some other fossils had been collected at some point not designated on Bijou Creek.

Cross is of the opinion that these fossils came from what are called by him the Arapahoe beds, a formation overlying the Laramie. Cope's type of his *Adocus? lineolatus* is now in the American Museum of Natural History and has the number 1844. Cope's figures represent well the specimens; but since they have been figured the surface has been scraped from the neural, so that its sculpture no longer appears. That of the fragment of plastron remains. It is obscure, but consists of elongated, very shallow pits, four or five in a line 5 mm. long, and arranged more or less in rows and separated by low narrow ridges. The neural has a maximum width of 28 mm. and a thickness of 7 mm. The plastral bone is 8 mm. thick at the sutural border. This suture is coarse and, as Cope says, has a median serrate keel, with pits on each side of it for the reception of processes from the bone with which it articulated.

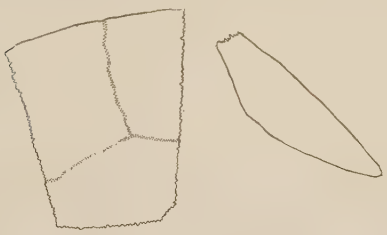
Cope stated that the species comes also from the mouth of the Big Horn River, but the present writer does not know of any specimens on which this identification was based. Cope likewise includes the species in his list of Judith River species. Lambe, as cited, reports it from the Belly River beds on Red Deer River, Alberta, British America. His specimens too were fragmentary. Specimens with a sculpture very similar have been brought to the American Museum of Natural History from the Laramie beds of Montana. These were collected by

Mr. Barnum Brown, on Hell Creek, Montana. Fragments of costals scarcely, if at all, to be distinguisht from them are found in the collection made in the Judith River region for Professor Cope, by C. H. Sternberg, in 1876. It is the writer's opinion that it is unsafe to identify as belonging to *Adocus lineolatus* specimens from the Judith River and the Laramie beds before far better materials of the species have been collected from the type locality. And when these better materials have been secured from Bijou Creek, better specimens than yet obtained must be secured from the other formations mentioned. It is improbable that the same species continued from the Judith River epoch to the Arapahoe epoch. Meanwhile, even good fragments are worth preserving.

The specimen referred to above as having been collected by Sternberg from the Judith River region forms No. 6105 of the American Museum. It belonged to the third or the fifth costal. Its width is 32 mm.; its thickness, only 3.5 mm. There is no thickening along the middle on the under side corresponding to the rib. The outer surface is crost by the costo-vertebral sulcus. The ornamentation resembles in pattern that of Cope's *Compsemys imbricaria* (*Basilemys imbricaria*), and Cope has so labeled the bone; but the size of the areolæ is considerably smaller, there being 4 pits in a line 5 mm. long, instead of 3 or less. The ridges between the areolæ are low and run at right angles with the sutural borders of the bone.

A fragment of a costal from Hell Creek, Montana, collected by Mr. Barnum Brown, is catalogged under the number 1014 of the American Museum. The costal is 36 mm. wide and 5 mm. thick. The sculpture is similar to that of the Judith River specimen just described, but is more obscure.

A peripheral, the second of the left side, has the number 1014, but it belonged to a much larger individual. It is represented by figs. 308 and 309. The bone is 55 mm. high, 48 mm. along the free border, and 32 mm. along the costal border. Fig. 309 represents the border joining the first peripheral, the greatest thickness being 16 mm. The sutural border for the third peripheral has a maximum thickness of 24 mm. The sculpture has the pattern and the fineness ascribed to the costal. It resembles greatly that of the fragments numbered 6103 A. M. N. H. and described under *Basilemys imbricaria*.



FIGS. 308 AND 309.—*Adocus lineolatus*. Peripheral and section. ×½. No. 1014 A. M. N. H.

308. Second left peripheral.
309. Section of same peripheral at union with third.

No. 6107 A. M. N. H. includes a fragment of a costal plate and another of a plastral bone which were collected for Professor Cope, in 1877, by Mr. J. C. Isaac, in the Laramie of Converse County, Wyoming. The sculpture of these bones resembles closely that of *A. lineolatus*, type.

Genus AGOMPHUS Cope.

Shell thick and heavy in the known species. Free borders of the carapace thickened and obtuse. Exposed surfaces of the shell not pitted. Hinder marginal scutes not rising on the costal bones, except slightly in one species. Inframarginal scutes present. The pectoral scutes extending forward to the hinder end of the epiplastrals. Intergulars not known. Nuchal with costiform processes. Rib-heads more strongly developt than in *Adocus*.

Type: *Agomphus turgidus* Cope.

The genus *Agomphus* was founded by Cope in 1871 (Proc. Amer. Philos. Soc., XII, p. 46) having *A. turgidus* as the type. The only character given was the apparent lack of gomphosis between the costals and the peripherals; an insufficient character, if a true one. In 1882 (Proc. Amer. Philos. Soc., XX, p. 145) Cope placed *Agomphus* with *Dermatemys* in the Emydidæ, characterizing it as possessing 2 anal marginal scutes, a series of inframarginals, and with the lobes of the plastron wide. The same views are repeated in that author's Vertebrata of the Tertiary Formations of the West, in 1884. In both the publications referred to, the genus *Amphiemys* was placed among the Adocidæ. Baur in 1888 (Zool. Anzeiger, XI, p. 595) reduced *Amphiemys* to the position of a synonym of *Agomphus* and arranged the latter under

the Adocidæ. In 1891 (Proc. Acad. Nat. Sci. Phila., p. 429) Baur retains *Agomphus* in the Adocidæ and gives as its distinguishing characters the narrow lobes of the plastron and the shorter bridge. He states too that it has costiform processes which reach the second peripheral, piercing the first.

The general form of the shell of the species of this genus is indicated by that of *A. tardus* Wieland.

KEY TO THE SPECIES OF AGOMPHUS.

A^1. Upper Cretaceous species.
- a^1. With the costo-peripheral sulci, so far as known, confined to the peripheral bones.
  - 1. Plastron nearly flat transversely; entoplastron broadly rounded behind; pectoro-abdominal sulcus much nearer the hyohypoplastral suture than to entoplastron; costo-marginal sulci above middle of peripheral bones; costal border of peripherals much thinner than maximum thickness ..... *turgidus*
  - 2. Plastron strongly convex transversely; costo-marginal sulci below middle of peripherals ..... *petrosus*
  - 3. Like *petrosus*, but plastron not so convex; costo-marginal sulci above middle of peripherals; costal border of peripherals not much thinner than maximum thickness ..... *tardus*
  - 4. Entoplastron pointed behind; pectoro-abdominal sulcus nearer hyohypoplastral suture than to entoplastron; suture between the hyoplastra 0.25 of the hyohypoplastral suture ..... *pectoralis*
  - 5. Entoplastron truncated behind; pectoro-abdominal sulcus nearer entoplastron than to hyohypoplastral suture ..... *firmus*
- a^2. Costo-peripheral sulci of 11th and 12th marginal scutes rising above the peripherals.
  - 1. Entoplastron pointed behind; suture between hyoplastrals 0.35 of the hyohypoplastral suture ..... *masculinus*

A^2. Early Tertiary species.
- 1. With hinder lobe of plastron much narrowed behind ..... *oxysternum*

Agomphus turgidus Cope.

Plate 37, figs. 1–5; text-fig. 310.

Emys turgidus, COPE, Ext. Batrach., Reptilia, Aves N. A., 1869, pp. 125, 127.—?WIELAND, Amer. Jour. Sci. (4), XX, 1905, p. 440, fig. 9, in part.

Agomphus turgidus, COPE, Proc. Amer. Philos. Soc., XII, 1871, p. 46; Vert. Cret. Form. West, 1875, p. 262.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.

This species, the type of the genus *Agomphus*, is based on portions of the skeleton which were obtained from the upper greensand bed of the Cretaceous of New Jersey. The materials consist of both hyoplastra somewhat damaged; the entoplastron; the fourth neural; the proximal ends of the third, fourth, fifth, and sixth costals of the left side, and of the third, fourth and sixth of the right side; some fragments representing the distal ends of costals; and four peripherals, one from the bridge. The specimen is now in the Cope collection in the American Museum of Natural History, and bears the number 1481.

The portion of the plastron (plate 37, fig. 1) preserved has been considerably eroded. The epiplastrals being gone, nothing is known regarding the form of the front of the plastron. The front lobe had a width of 90 mm. at the base. The free border, as far as represented, is thin and rounded in section, and a shallow groove runs parallel with it on the upper side. Toward the midline the bone thickens rapidly, and at the hinder border of the entoplastron it is 14 mm. thick. This increases to 17 mm. at the crossing of the median longitudinal and transverse sutures. The entoplastron is rather pointed in front, broad and rounded behind. It is slightly broader than long, thin in front (6 mm.) and thick behind (14 mm.).

The transverse suture behind the hyoplastrals is somewhat irregular in direction. The denticulations are fine, but there are some grooves and keels near the midline.

Professor Cope states that only the longitudinal median sulcus is to be made out. Yet to the present writer it seems clear that there is one which crosses the entoplastron, the humero-pectoral, and another which crosses the hinder ends of the hyoplastrals, the pectoro-abdominals. These are in exactly the positions of the corresponding sulci in *A. pectoralis*. The

surface of the plastron appears to have been somewhat uneven, but no definite pattern of sculpture can be made out.

The fourth neural (plate 37, fig. 5) has a length of 27 mm., a width of about 24 mm., and a thickness of 11 mm. The costals at the proximal ends are as thick as the neurals, but they rapidly become thinner, so that at a distance of 30 mm. from the neurals a costal is only 5.5 mm. thick; and this thickness is maintained to the distal ends. The capitula of the ribs are well developt. The sulci limiting laterally the vertebral scutes are deeply and sharply imprest. These vertebral scutes were rather narrow, about 43 mm. wide. The third vertebral has a length of 60 mm. The surface of the bone is finely striated longitudinally.

Plate 37, fig. 4, represents 3 peripherals which appear to have had the positions assigned to them, the eighth, ninth, and tenth of right side, but possibly the ninth, tenth, and eleventh. The one seen on the right of the figure is the anterior, but it did not articulate with the hypoplastron. Each has an extreme thickness of about 11 mm. The exterior surface is concave vertically, while the inner surface is strongly convex. Fig. 310 is a section through the middle one of the three. Altho the free edge of the series is somewhat eroded, it evidently was rounded. Further forward this edge appears to have been more angulated, until, as represented by one of the bridge peripherals, the upper side of the shell made abruptly an angle of about 45° with the lower side. The marginal scutes of this species were confined to the peripheral bones, instead of extending upward on the costals. As shown in the figures, the costal scutes come down well on the peripherals.

The carapace of this species had a length of about 265 mm.

In the Cope collection at the American Museum there is a pair of hyoplastrals, No. 1479 (plate 37, fig. 2), which evidently belongs to this species and which is labeled as having been found at Mount Holly, New Jersey, in 1870. It has the size of the corresponding bones of the type, but it is considerably thicker, being 20 mm. just behind the entoplastral notch and also at the hinder border of the bones near the midline. About one-third the distance from the notch toward the rear the thickness is 22 mm. This specimen displays the pectoro-abdominal sulcus and a portion of the inframarginal scutes on the left side. The latter appear to have been arranged as in *A. pectoralis*. The median sulcus is obscure, but what appears to be a portion of it is seen on the right side running backward from the transverse sulcus, while apparently another short branch is seen on the left side.

FIG. 310.—*Agomphus turgidus*. Section across ninth peripheral of type. $\times\frac{3}{4}$.

The surface of the plastron contains several large shallow pits and long grooves, as shown in the figure cited. It is evident that these have been made during the life of the animal, the result probably of some disease. Fig. 3 of plate 37 represents the same hyoplastrals seen from the front.

Agomphus petrosus Cope.

Plate 36, fig. 4; plate 37, figs. 6, 7; text-figs. 311–313.

Adocus petrosus, COPE, Proc. Acad. Nat. Sci. Phila. 1868, p. 236; Cook's Geol. New Jersey, App. B, 1868 (1869), p. 734; Proc. Amer. Philos. Soc., XI, 1870, p. 295.

Emys petrosus, COPE, Ext. Batrach., Reptilia, Aves N. A., 1869, pp. 125, 126.

Agomphus petrosus, COPE, Proc. Amer. Philos. Soc., XII, 1871, p. 46; Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 625; Vert. Cret. Form. West, 1875, p. 262.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.

The type of this species is now a part of the Cope collection in the American Museum of Natural History in New York. It consists of a portion of the right hyoplastron; 5 peripheral bones, with perhaps a fragment of another; portions of four costal bones; a fragment of the right hypoplastron; and what Cope regarded as the head of the coracoid, but which seems to be rather the articular end of the pubis. These have been catalogged under the number 1482. They were collected from the upper greensand bed of the Cretaceous, at Gloucester, New Jersey.

The plastron (plate 36, fig. 4) was not flat below like that of the species of the other species of *Agomphus*, but very convex. Cope states that the curvature from the peripherals

of one side to those of the other amounts to 124°. Unfortunately the free border of the front lobe has not been preserved, so that it is impossible to determine the width of the lobe at the base; but it could not have been far from 100 mm. The notch for the entoplastron shows that this bone had a width of 42 mm. It appears to have been broadly rounded behind. While the thickness at the hinder border was about 17 mm., it was much thinner at the front. The thickness of the hyoplastron a short distance behind the entoplastron is 20 mm.; at the hinder border of the hyoplastron in the midline, 15 mm.; at the articulation with the fifth peripheral 10 mm. The bone is therefore very thick and its tissue is dense and heavy.

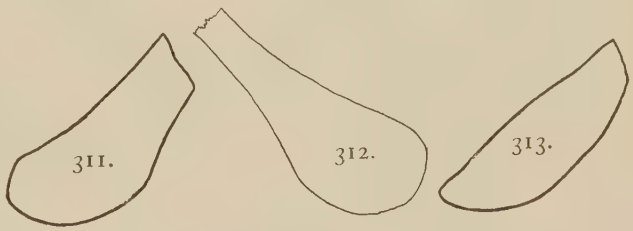
There is present a fragment of the free border of the hypoplastron, including a portion of the sutural border for the xiphiplastron. At a distance of 28 mm. from the free border the bone is 18 mm. thick. This continues to within about 20 mm. of the border, and then the bone is rapidly beveled off to a blunt edge. The lower surface of the bone curves upward to meet the bevel.

The surface of the hyoplastron and of the fragment of the hypoplastron is very smooth, having apparently been polisht during the life of the animal. The proximal end of the first costal is preserved. Its neural border is concave for the first neural. Its hinder angle joined the second neural. Here the bone is 12 mm. thick. In front it is 8 mm. thick. On the under side are seen the base of the rib-head and articulation for the first rib.

Two adjacent costals of the right side (plate 37, fig. 7), the fourth and the fifth, or the fifth and the sixth, are present. They are each 45 mm. in width at the proximal end. At the suture with the neurals they are 16 mm. thick; at a distance of 60 mm. from the neurals one has still a thickness of 9 mm. The capitula of the ribs are moderately developt. Little or no trace is left of the rib on the inner side of the costal plates. These costals are considerably archt, showing that, with the curvature of the plastron, the shell was high and vaulted.

FIGS. 311–313.—*Agomphus petrosus*. Peripherals of type. ×¾.

311. Section at anterior end of second peripheral.
312. Section at anterior end of supposed eighth peripheral.
313. Section across supposed first peripheral of left side.



Two anterior peripherals (plate 36, fig. 4), the second and the third of the right side, are connected with the outer anterior angle of the hyoplastron. They are thick and massive. The free edge of these peripherals is rounded like the edge of one's hand, and at the anterior end of the second the border is slightly everted. Fig. 311 represents a section taken at this point. The thickness here is 15 mm. The second peripheral is 40 mm. in length along the free border and 40 mm. high. The third is 50 mm. long. The hinder border of the latter peripheral and the anterior lateral process of the hyoplastron furnish the articular border for the fourth peripheral; while behind this is a part of the articular border for the fifth peripheral. Two of the hinder peripherals (plate 37, fig. 6), supposed by Cope to have been the eighth and the ninth, are at hand. The supposed eighth did not articulate with the hypoplastron as it appears to have done in Wieland's *A. tardus* and may therefore be the ninth. The fragment of costal attacht to it appears to be the fifth, since on it there is no trace of a descending sulcus. These, with the distal end of the fifth costal, are figured on plate 37. Fig. 312 presents a section across the anterior end of the supposed eighth. The free borders of these peripherals are thick and rounded like those of the anterior peripherals. The greatest thickness of the eighth is 20 mm.; but where the bone articulates with the costal the thickness is reduced to 6 mm. The ninth peripheral has the border considerably flared upward and more acute than further forward. Accompanying the type is another peripheral (fig. 313) which Cope has labeled as the first of the left side. On one side there is an excavation, as if for the nuchal. However, there are difficulties in regarding it as the first peripheral of this species One of these is the great thickness of the bone where it would come in contact with the second peripheral, being 19 mm., whereas the corresponding border of the second peripheral of the right side is only 16 mm. thick. Again, as the upper surface approaches the free border, it curves

downward; whereas, the border of the second peripheral is turned upward. It is probable that the bone is an intrusion from another species.

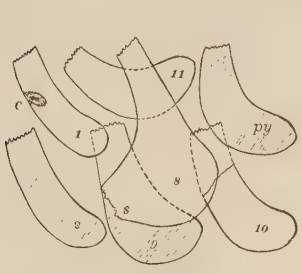
The sulci of the plastron are wholly effaced. On the costals they are narrow, but distinct. As seen from plate 37, fig. 7, the sulci limiting the vertebral scutes laterally are not far removed from the costo-neural sutures. The first vertebral was evidently wider than those succeeding it. If the neurals had the relative width that they have in *Adocus punctatus*, the third vertebral must have been 52 mm. wide. On the second and third peripherals the longitudinal sulci lie not far above the free border of the carapace. The sulci on the supposed eighth and ninth peripherals are so obscure that they can not be traced.

Agomphus tardus Wieland.

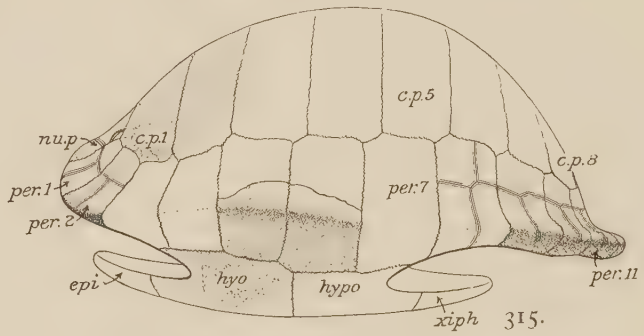
Text-figs. 314–318.

Agomphus tardus, WIELAND, Amer. Jour. Sci. (4), XX, 1905, p. 430, figs. 1–7.

This species was found in the Cretaceous marl pits at Birmingham, Burlington County, New Jersey, in 1869. The type forms number 774 of the Marsh collection at Yale University. The parts recovered are most of the nuchal, the second and the fifth neurals, the first and second left costals; fragments of the third and fifth, and the whole of the eighth right costals; of the right peripherals, the first, eighth, ninth, and tenth; of the left side the fifth, sixth, tenth, and the eleventh; the left hyoplastron, and the right hypoplastron. These parts have enabled



314.



315.

FIGS. 314 AND 315.—*Agomphus tardus*. Carapace of type.

314. Sections at anterior ends of peripherals indicated by the numerals. $\times\frac{2}{5}$. *c*, in first peripheral, pit for process of nuchal. *s*, in eighth peripheral, sutural border for union with hypoplastron; *py*, section of pygal.

315. Shell seen from left side. ×0.23 *c. p.* 1, etc., costal plates; *epi*, epiplastron; *hyo*, hyoplastron; *hypo*, hypoplastron; *nu. p*, nuchal plate; *per.* 1, *per.* 2, etc., peripheral bones; *xiph*, xiphiplastron.

Dr. Wieland to restore satisfactorily the form of the shell. A number of his figures are here reproduced.

The bones of this species were even thicker and heavier than in *A. petrosus*. The shell (figs. 314–318) was elongated and rather high. From the highest point the carapace sloped gently to the front, while the rear sloped rapidly downward. The length of the carapace was about 330 mm.; the greatest breadth, about 230 mm. The nuchal bone is 53 mm. long and 52 mm. wide along the free margin. It is 13 mm. thick near the free margin and 7 mm. thick posteriorly. The second neural has a length of 40 mm., an extreme width of 35 mm., and a thickness of 14 mm. The fifth neural is 40 mm. long, 36 mm. wide, and 15 mm. thick. As in *A. petrosus*, the first costal attains considerable thickness at the junction with the second and third peripherals, being here 22 mm. thick. The rib-heads are diminutive. All the peripherals are very obtuse at their free borders. Fig. 314 shows the form of the anterior end of the first, the second, the eighth, the ninth, the tenth, and the eleventh peripherals, as well as of the border of the pygal that joins the eleventh peripheral. It will be observed that the thickness of the first and the second near the middle of the height is maintained to the costal border.

The nuchal scute is moderately broad. The sulci bounding the vertebrals and the costals have not been observed. The costo-marginal sulci run along on the upper half of the peripherals, without at any time reaching the costal bones.

The entoplastron is not present, but the notch in the front of the hyoplastron shows that the entoplastron was broadest behind. Its width was about 45 mm. The hyoplastron (fig. 318) is 60 mm. long on the midline and about 100 mm. wide. Its greatest thickness, at the midline, is 27 mm. Laterally it thins to about 9 mm. The hypoplastron is 62 mm. long on the midline, 95 mm. wide, and 31 mm. thick. The bridge was about 106 mm. wide.

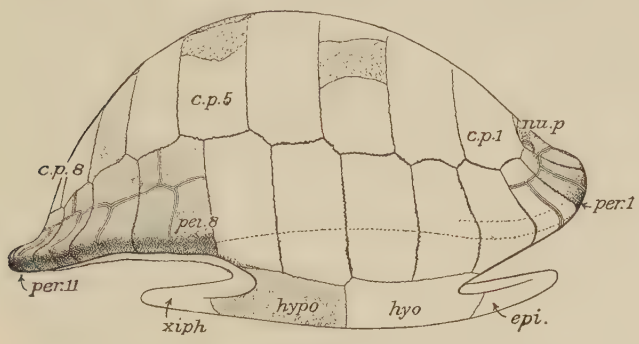
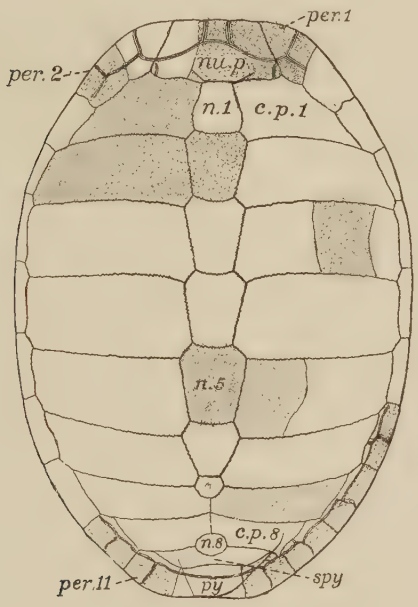


FIG. 316.—*Agomphus tardus*. Shell of type, seen from right side. ×0.23. Lettering with same signification as in Fig. 315.

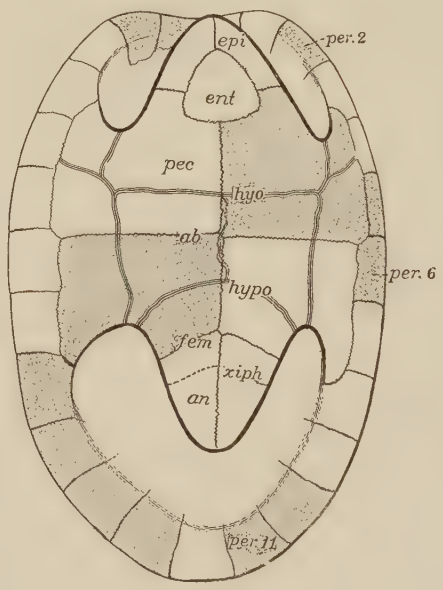
No sulcus has been observed crossing the front of the hyoplastron and the entoplastron. The pectoro-abdominal crosses in front of the hyohypoplastral suture, as in *A. petrosus*. The abdomino-femoral sulcus swings well forward on the hypoplastrals. So far as observed, there is only an axillary inframarginal and behind it a single additional scute. It seems probable that the latter will be found to have been subdivided.

This species appears to differ from *A. petrosus*, its closest ally, in the following respects: The marginal scutes extend higher on the peripheral bones; the second peripheral is relatively higher; this peripheral of *A. tardus* is not so thick near the free border, but thicker at the upper

317.



318.



FIGS. 317 AND 318.—*Agomphus tardus*. Shell of type. ×0.23.

317. Carapace, seen from above. *c. p.* 1, *c. p.* 8, costal plates; *n.* 1, *n.* 8, neural bones; *nu. p*, nuchal bone; *per.* 1, *per*, 11, peripheral bones; *py*, pygal; *spy*, suprapygal.

318. Shell, seen from below. *ab*, abdominal scute; *an*, anal scute; *epi*, epiplastron; *ent*, entoplastron; *fem*, femoral scute; *hyo*, hyoplastron; *hypo*, hypoplastron; *pec*, pectoral scute; *per.* 2, *per.* 6, *per.* 11, peripheral bones; *xiph*, xiphiplastron.

border than in *A. petrosus;* the third peripheral is not so long (38 mm.) as it is in *A. petrosus* (45 mm.); the upper, or costal, borders of *A. tardus* are thicker and the outer end of the hyoplastron has not so strong an upward curve as in *A. petrosus*.

From *A. turgidus* this species differs in having the peripherals nearly as thick at their costal borders as the maximum thickness.

Agomphus pectoralis (Cope).

Plate 37, figs. 8, 9.

Pleurosternum pectorale, Cope, Proc. Acad. Nat. Sci. Phila. 1868, p. 236; Cook's Geol. New Jersey, App. B, 1868 (1869), p. 734; Ext. Batrach., Reptilia, Aves N. A., 1869, p. 130.

Adocus pectoralis, Cope, Batrach., Reptilia, Aves N. A., 1869 (1870), pp. ii, 233, plate vii, fig. 1; Proc. Amer. Philos. Soc., xi, 1870, pp. 296, 548; Proc. Amer. Philos. Soc., xii, 1871, p. 43; Vert. Cret. Form. West, 1875, p. 262.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 444.

The first mention of this species, under the name *Pleurosternum pectorale*, occurs in the Proceedings of the Academy of Natural Science, Philadelphia, 1868, page 236, in the description of *Agomphus petrosus*. This mention may be regarded as sufficient to fix the date of the species, altho the description is very brief and only incidental. Under the same name a full description and a figure were publisht in 1869, in the author's work, Synopsis of the Extinct Batrachia, Reptilia and Aves of North America. In a part of the same paper issued in 1870, the species was assigned to the genus *Adocus*. To the present writer the species appears to belong to *Agomphus*.

Agomphus pectoralis is up to the present time known to us by only the type specimen, which consists of both hyoplastral bones (plate 37, figs. 8, 9). These are now in the Cope collection, in the American Museum of Natural History, in New York, and they have the catalog number 1478. The specimen was found in the upper bed of the Cretaceous greensand, near Medford, New Jersey. These hyoplastrals are complete, extending from the sutures for the bridge peripherals of one side to those of the other. The width from side to side is 146 mm. The free borders of the anterior lobe pass by a broad curve into the axillary notch, making it difficult to determine accurately the width of the front lobe at the base. It may be regarded as about 85 mm.

The free borders of the epiplastrals are subacute, and from them the bone thickens gradually to the median longitudinal suture. At the hinder angle of the entoplastron the thickness is 15 mm.; at the hinder border of the hyoplastrals, in the midline, the thickness is 20 mm. Where these bones have joined the peripherals of the bridge, they are only 8 mm. thick.

The hyoplastrals are deeply notcht for the reception of the entoplastron. This is prolonged further backward than in the other species of the genus. The axillary notches, too, are very deep and narrow. Outside of each notch the hyoplastron sends upward and forward a strong process, or buttress, against the carapace. Inwardly this forms a sharp crest.

The dermal scutes of this species differ considerably from those of the species of *Adocus*. Professor Cope thought that there had been a fusion of the humeral and the pectoral scutes, and that the sulcus seen crossing the extreme anterior end of the left hyoplastron was the posterior boundary of the gular scute. It seems more probable, however, that this sulcus represents the posterior limit of the humeral. This interpretation throws the humero-pectoral sulcus indeed far forward, but it is little more so than it is in *Dermatemys mawii* (Boulenger, Cat. Chelonians, p. 28, fig. 8). On the outer ends of the hyoplastrals there are represented three inframarginals. The axillary is small and, outside of the notch, extends well forward. The second inframarginal is hexagonal and represents the hinder end of the axillary of *Adocus punctatus*. The third inframarginal rested principally on the hypoplastron. In *Alamosemys substricta* the arrangement is somewhat as in the species here described. The whole arrangement of the scutes resembles closely that of *Dermatemys mawii*, and there is little in the species as known to exclude it from that genus. The species is here referred to the genus *Agomphus* because of its close resemblance to *A. turgidus*. Only specific differences are observable.

Agomphus firmus (Leidy).

Emys firmus, Leidy, Proc. Acad. Nat. Sci. Phila. 1856, p. 303; Smithson. Contrib. to Knowl., xiv, 1865, p. 106, plate xix, figs. 2, 3.—Cope, Ext. Batrach., Reptilia, Aves N. A., 1869, pp. 126, 127.—Maack, Palæontographica, xviii, 1869, p. 277.

Adocus firmus, Cope, Proc. Acad. Nat. Sci. Phila. 1868, p. 235; Cook's Geol. New Jersey, 1868 (1869), p. 734; Proc. Amer. Philos. Soc., xi, 1870, p. 295.

Agomphus firmus, Cope, Proc. Amer. Philos. Soc., xii, 1871, p. 46; Vert. Cret. Form. West. 1875, p. 262.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.—Wieland, Amer. Jour. Sci. (4), xx, 1905, p. 443.

The materials possest by Leidy when he described this species consisted of the third, sixth, and the seventh left peripherals, the sixth, seventh, and eighth peripherals of the right side, a portion of the left hyoplastron, and a portion of the right hypoplastron. These had been placed in Dr. Leidy's hands by Professor George H. Cook, of the New Jersey Geological Survey. They had been found in the uppermost Cretaceous greensand, at Tinton Falls, Monmouth County, New Jersey. The sixth and seventh left peripherals and the parts of the plastron were figured by Leidy, as cited above, and these are now in the State collection at Rutgers College, New Brunswick, New Jersey. The peripherals mentioned by Leidy are not in this collection at present.

For figures of the scanty remains forming the type the reader is referred to Leidy's paper in the Smithsonian Contributions cited in the synonymy.

The length of the figured peripherals is 140 mm. The height of the seventh is 93 mm. The costo-marginal sulcus crosses these peripherals between the upper and middle thirds. This shows that the species does not belong to *Adocus*.

The left hyoplastron has a length of 80 mm., altho its length along the median suture is somewhat less. The hypoplastron had a length of 85 mm. but only 65 mm. at the midline. As shown by Leidy's figure, the hypoplastron articulated both in front and behind with the bones of the opposite side, a condition not unusual with the members of the family. The thickness of the hyoplastron at the midline and just behind the entoplastron is 26 mm. The greatest thickness of the hypoplastron is 19 mm.

The excavation in the front of the hyoplastron shows that the entoplastron was truncated behind and that its width was about 65 mm. The pectoro-abdominal sulcus crost the hyoplastron somewhat in front of the middle of its length; while the abdomino-femoral crost the hypoplastron about the middle of its length.

This species, known up to the present time from only the type specimens, differs from all the other described species of *Agomphus* in having the entoplastron truncated behind and in having the pectoro-abdominal sulcus cross nearer the entoplastron than to the hinder border of the hyoplastron.

Agomphus masculinus Wieland.

Fig. 319.

Agomphus masculinus, WIELAND, Amer. Jour. Sci. (4), XX, 1905, p. 437, fig. 8.

The type of this species belongs to the Marsh collection at Yale University Museum and is numbered 671. It consists of the complete plastron and some portions of the carapace, including some of the hinder peripherals. It was collected in the Upper Cretaceous marl bed at Barnesboro, Gloucester County, New Jersey, in 1872.

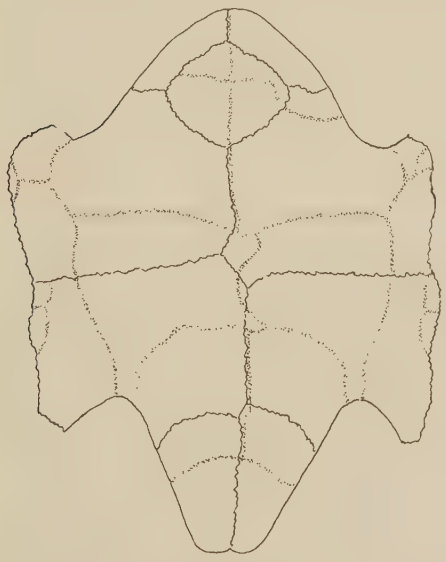


FIG. 319.—*Agomphus masculinus*. Plastron of type. $\times\frac{2}{5}$. Redrawn from Wieland's figure.

The plastron (fig. 319) resembles closely that of *A. turgidus*, so far as the latter is represented. Dr. Wieland has mentioned one character which differentiates the carapace from that of Cope's species just mentioned. In *A. masculinus* the eleventh and twelfth marginal scutes overlap the lower ends of the eighth costal bone and the suprapygal; whereas in *A. turgidus* these marginals do not rise above the peripherals. This appears to be a sufficient specific distinction.

The length of the plastron is 170 mm.; the extreme width, 130 mm. The anterior lobe narrows rapidly from the base to the blunt tip. The width of the base of the lobe is about 92 mm.; the length, 41 mm. The epiplastrals are narrow. The entoplastron is subrhombic, 33 mm. long and 36 mm. wide. Its thickness is 15 mm. The other plastral bones are unsymmetrical, as is common among the older turtles. The left hyoplastron joins the right

hypoplastron a distance of 14 mm.; while the right hypoplastron comes into contact with the left xiphiplastron. The greatest thickness of the hyoplastron and hypoplastron is 18 mm. The distance between the entoplastron and the xiphiplastron is 84 mm. Half of this may be regarded as belonging to the hyoplastrals; the other half to the hypoplastron.

The bridge is 100 mm. wide. The hinder lobe is much reduced. The width at the base is about 68 mm.; its length, 48 mm. The greatest thickness of the xiphiplastra is 16 mm.

The plastral scutes are well exhibited. Leaving out of count the inframarginals, there are 5 pairs of plastral scutes, instead of the 7 that we find in *Adocus*. One pair occupies the area covered in *Adocus* by the intergulars, the gulars, and the humerals. This pair joins along the midline a distance of 23 mm. The members of the pair differ somewhat in size and form. Behind this pair the median sulcus is erratic in its course. The pectorals measure 48 mm. along the midline; the abdominals, 31 mm.; the femorals, 38 mm.; the anals, 28 mm. Here, as in *A. tardus*, there appear to be only two inframarginals on each bridge, a small axillary scute and a very large scute behind this, reaching to the inguinal notch. Some of the marginal scutes descend on the outer ends of the plastral bones.

As stated, the eleventh and twelfth marginal scutes rise above the superior borders of the peripherals supporting them. In front of them the marginals are confined to the peripherals.

Agomphus oxysternum (Cope).

Fig. 320.

Amphiemys oxysternum, Cope, Proc. Amer. Philos. Soc. xvii, 1877, p. 82; Palæontolog. Bull. No. 25, 1877, p. 2; Amer. Naturalist, xii, 1878, p. 129.

Agomphus oxysternum, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.—Wieland, Amer. Jour. Sci. (4), xx, 1905, p. 443.

The type of the present species is in the collection of the Geological Survey of Georgia, at Atlanta, where the writer has been permitted to study it. The specimen was found near Montezuma, Macon County, near the Flint River, in what is known as the Midway formation, a member of the Lower Eocene. It is in the same condition as when it was described by Professor Cope, the plastron being present, as well as the anterior portion of the carapace and the left border as far as the hinder end of the eighth peripheral. The core of matrix which filled the shell is in large part present and on it are indicated the sutures between the series of neural and costal bones. In form the shell appears to have been similar to that of *A. tardus*.

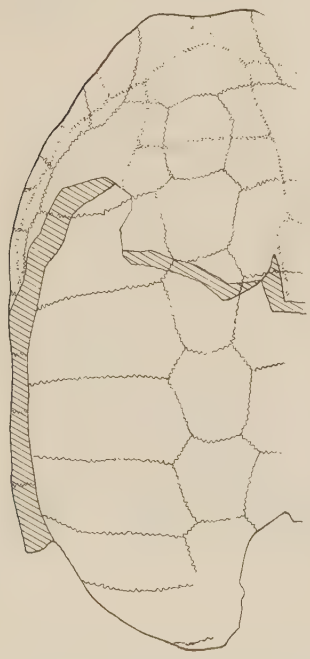


Fig. 320.—*Agomphus oxysternum*. Carapace of type. $\times\frac{1}{3}$.

The length of the carapace, from the front of the nuchal to the hinder border of the seventh costal, is 242 mm. Cope gives this as 250 mm. The width is 184 mm.; the height, 150 mm. or a little more.

The free border in front of the bridge is thick, obtuse, and slightly flared upward. The hinder end of the eighth peripheral is 18 mm. thick, and the free border is very obtuse. The nuchal bone measures about 50 mm. along the free border, 75 mm. where widest, and 41 mm. from front to the rear. The neurals, except the first, are slightly wider than long. The dimensions of three of them are given in the table on the following page.

The neurals and costals are thick. Cope states that the second neural is 13 mm. thick; the second costal, 12 mm. The latter bone near the neural is only 10 mm. thick. The first peripheral measures along the free border 38 mm.; the third, 40 mm. The first is 33 mm. high; the second, 38 mm.

The first vertebral scute is 53 mm. long and 52 mm. wide. Its lateral borders are nearly parallel. The second vertebral is 70 mm. wide. The marginal scutes, as far backward as the middle of the bridge, run about 40 mm. below the costo-peripheral sutures.

The plastron has the extremities of the front and hinder lobes slightly elevated above the portion between the bridges. The length is 211 mm. The anterior lobe is broadly rounded in front; the posterior is short and pointed behind. The width of the anterior, on a line crossing at the hinder border of the entoplastron, is 102 mm.; its length is 57 mm. The entoplastron is pointed in front, rounded behind, 42 mm. long and 46 mm. wide. The bridge has a width of 94 mm. The hinder lobe has a width, taken from the ends of the abdomino-femoral sulci, of 88 mm. Its length is 57 mm.

Neural.	Length.	Width.
1	38	27
2	31	33
5	31	32

Some of the sulci of the plastron are very obscure. Cope was in doubt regarding some of those on the anterior lobe. One sulcus crosses the entoplastron 37 mm. behind the front of the lobe. Cope regarded this as the gulo-humeral; the writer regards it as the humero-pectoral. The area in front of this appears to the writer to be divided on each side into an intergular, whose extent backward is doubtful, a small triangular gular, and a large humeral. Cope appears to have been doubtful whether the sulcus behind the scutes, called by the present writer gulars, continued directly across the front lobe, cutting off intergulars in front, or turned backward and reacht the sulcus which crosses the entoplastron.

Cope found evidences of a sulcus, his humero-pectoral, which commenct near the axillary notch, ran forward parallel with the free border of the lobe, then turned inward and somewhat backward, to cross the midline a little behind the entoplastron. The present writer, examining the plastron without knowing Cope's determinations, did not observe such a sulcus. It is not found on other species of *Agomphus*.

According to the writer's determinations, the pectoral scutes join along the midline a distance of 58 mm.; the abdominals, a distance of 26 mm. The femoro-anal sulcus appears to be where drawn. Cope concluded that inframarginal scutes are present. The writer has no doubt regarding this.

Dr. George Baur (Zool. Anzeiger, XI, 1888, p. 595) stated that he had examined the type of this species and regarded it as belonging to the genus *Agomphus*. He also informed us that additional materials existed in the Yale University collection, but nothing further has been heard of them.

Genus ZYGORAMMA Cope.

Characters, so far as known, those of *Adocus*, except that the hypoplastron sends no buttress to the costals, but each sends a process into a pit between the seventh and eighth peripherals. Bones of the carapace and plastron comparatively thin. Costals articulating with peripherals by suture and gomphosis. Rib-heads feebly developt, except on the first costals. Surface of carapace striated. Posterior marginal scutes rising on the costal bones as in *Adocus*.

Type: *Zygoramma striatula* Cope.

Zygoramma striatula Cope.

Plate 37, fig. 10; plate 38, figs. 1–3; text-fig. 321.

Zygoramma striatula, Cope, Proc. Amer. Philos. Soc., XI, 1870, p. 550; Ibid, XII, 1871, p. 44; Vert. Cret. Form. West, 1875, p. 263.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.

This species was based on rather fragmentary materials which were collected from the upper greensand bed of the Cretaceous, at Pemberton, Burlington County, New Jersey. The remains consist of the greater portion of both hypoplastra, 5 posterior peripherals, and fragments of 3 costal bones. This type is in the American Museum of Natural History and bears the catalog number 2358.

The hypoplastrals (plate 38, fig. 1) are thin, the thickness everywhere along the hyo-hypoplastral suture present being only 6 mm. Near the midline, just in front of the suture with the xiphiplastrals, the thickness is 7 mm., increasing to 9 mm. near the free border, behind the inguinal notch.

The sutures are coarse, each bone sending large teeth into pits of the other. These pits and teeth belong to the deeper layers of the bone; while the sutures, as seen from below,

form nearly smooth lines. The hypoplastra meet along the midline a distance of 80 mm. The one of the right side has articulated by its anterior angle with the left hyoplastron for a short distance. The free border of the left hypoplastron is present from the inguinal notch to xiphiplastral suture. Below, it presents an acute edge; but the bone thickens rapidly. Outside of the notch a process is sent outward and upward to enter a pit between the seventh and eighth peripherals. The abdomino-femoral sulcus crosses the hypoplastra a little nearer the anterior end of these bones. The region where we might expect to find the inframarginal scutes is broken away. The longitudinal median sulcus is not seen.

The sculpture of the plastron is obscure, but there are evidences everywhere of shallow pits, and these were arranged, at least partly, in rows.

There are preserved the distal ends of 2 costals, one of which is the sixth of the right side, while the other belongs to the left side. The sixth of the right side (plate 38, fig. 2) is 38 mm. wide and 4 mm. thick. It is attacht principally to the eighth peripheral, but also to the anterior angle of the ninth. On the outer surface are seen parts of the third and fourth costal scutes, and of the eighth and ninth marginal scutes. The other distal end of a costal, probably the fifth of the left side, is 43 mm. wide and 4 mm. thick. A fragment of a costal from about the middle of the length of the bone is 35 mm. wide and 6 mm. thick. This seems to indicate that the costals thickened considerably toward the neurals.

Three successive peripherals of the right side are among the materials, the seventh, eighth, and ninth (plate 38, fig. 2). They are remarkable for their great height. The seventh measures 46 mm. along the free border; the eighth and ninth, each 49 mm. The height of the latter is 65 mm. The exterior surface of the seventh is convex, with the free edge flared slightly upward. The other two are not curved vertically, but are convex from front to back. The greatest thickness of the ninth is at the front border, 11 mm. The thickness is reduced upward to the sutural border, less rapidly downward to the sharp free edge. The eighth thickens rapidly toward the anterior end, where, at the middle of the height, the thickness is 23 mm. The thickening is exprest on the inner surface as a ridge. The hinder and lower inner portion of the seventh is likewise thickened, but the front and upper part is excavated by the visceral chamber. Above the thickened ridge, on the inside of each of these peripherals, is seen the mouth of a deep pit which received the free end of a rib. Two of these rib-ends are yet in place, one belonging to the sixth costal.

Between the seventh and eighth peripherals, on their inner side (plate 38, fig. 3), there is a deep pit, excavated principally in the seventh, which has received the extremity of the inguinal process of the hypoplastron. The latter did not rise to the height of the costal plates. From the front of the pit a sharp ridge runs downward and forward. This has its inwardly projecting edge broken away, but it quite certainly furnisht an articulation with the outer border of the hypoplastron. The seventh peripheral of the left side is present, but furnishes no additional information. A more posterior peripheral, possibly the eleventh, has the exterior surface considerably more concave vertically than that of the more anterior ones, showing that the hinder border of the carapace was flared upward. Plate 37, fig. 10, shows a fragment of a bridge peripheral with a portion of the end of a rib inserted in a furrow. Text-fig. 321 represents a section of a bridge peripheral showing that there was a sharp keel along the side.

FIG. 321.—*Zygoramma striatula*. Section across a bridge peripheral. ×½.

As will be observed from the plate, the hinder marginal scutes extended up on the costal plates. The ninth marginal has a width fore and aft of 52 mm., and a height of 85 mm. Its upper border displays some of the irregularities so common among the Dermatemydidæ. On the costal supposed to be the fifth of the left side the sulcus between the marginal and the costal scutes runs lower down.

The outer surface of the costals and peripherals is sculptured into low ridges and shallow grooves. These are mostly directed from the front of the bone backward, but often also slightly downward. The downward inclination is seen especially on the more posterior bones.

The length of the carapace of this specimen is estimated at 380 mm.

Zygoramma microglypha Cope.

Fig. 322.

Zygoramma microglypha, Cope, Proc. Amer. Philos. Soc., xii, 1871, p. 44; Vert. Cret. Form. West, 1875, p. 263.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.

The remains described under the above name were found at Birmingham, New Jersey, in the uppermost stratum of Cretaceous greensand. They consisted of the greater part of the plastron and half of the carapace, with 4 peripheral bones, of an individual whose carapace must have had a length of about 600 mm. A portion of this material has been recognized in the Cope collection of reptiles, in the American Museum of Natural History, and this bears the number 6129. Unfortunately, up to the present time, no bones of the plastron have been found in the collection. No part of the species has hitherto been figured.

The plastron is described as having a total length of 457 mm. According to Cope's measurements, the length of the hyoplastron was 81 mm.; that of the hypoplastron, 145 mm.; that of the xiphiplastron, 117 mm. The length of the hyoplastron was probably taken along the midline. The front of the plastron was truncated. The width of the entoplastron was 95 mm.; its length something less; its thickness 11.6 mm. The posterior border was truncated; the anterior border, regularly convex. The posterior plastral lobe was regularly contracted, and rounded, and it had a thin edge. Its width at the hypoxiphiplastral suture was 220 mm.; the thickness at the midline, 15.8 mm.

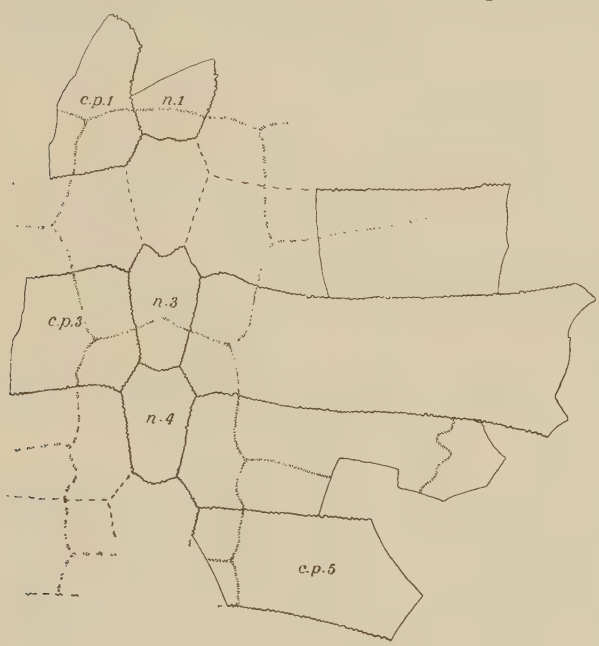


Fig. 322.—*Zygoramma microglypha*. Portion of carapace of type. $\times\frac{1}{4}$.

c. p. 1, *c. p.* 3, *c. p.* 5, costal plates; *n.* 1, *n.* 3, *n.* 4, neural bones.

The peripheral bones at the bridges are said to have had a thickened shoulder within, into which the slender costal processes were received. The free peripherals were of lighter construction and somewhat everted.

Most of the bones of the carapace that have been certainly identified are here figured (fig. 322). These consist of a portion of the first neural, the third and the fourth neurals, the proximal end of the first and third left costals, parts or wholes of the second, third, fourth, and fifth right costals, and portions of other costals whose positions can not be determined.

The first neural has a length of about 57 mm.; its width is 45 mm.; its thickness, 8 mm. The third and the fourth have each a median length of 60 mm. and a maximum width of 37 mm. Each is excavated in front for the preceding neural. Each has a thickness, where it joined the costal, of 10 mm. The first costal is 80 mm. wide; the second, 56 mm.; the third 59 mm.; the fourth, 55 mm. On the lower side of the first there is the base of a strong rib-head, and in front of this a rough articulation for the first rib. The rib-heads of the other costals are very feebly developt.

The sulci between the horny scutes are moderately distinct. The second vertebral had a length close to 105 mm. and a width about equal to the length. The first vertebral must have been considerably wider than the second. The third vertebral appears to have had a length of 115 mm. and a width close to 95 mm.

As in *Z. striatula*, the marginal scutes extend high up on the distal ends of the costal bones, as may be seen from the figure. They pursue an irregular course.

According to Cope, the intergular scutes formed a single shield, which was large, pentagonal, with straight sides, and broader than long. This shield separated widely the gulars from each other. The pectorals encroacht on the entoplastron; laterally they were narrow. The abdomino-femoral sulcus crost the hypoplastra a little behind their middle. The median longitudinal sulcus pursued an erratic course.

This species evidently resembled closely *Z. striatula*. The distinguishing character most obvious is the finer and conspicuously punctate sculpture. Cope states that the costal processes that fit into the peripherals of *Z. striatula* are relatively twice as large as those of *Z. microglypha*.

In its sculpture this species resembles the species of *Adocus*.

Genus HOMOROPHUS Cope.

A remarkable, but insufficiently known genus of Dermatemydidæ. Costal rib-heads wanting or vestigial. Neurals, in the type and only known specimen, co-ossified with the costals. The superior face of each neural much wider than the inferior face. Vertebral scutes in most places narrower than the neurals.

Type: *Homorophus insuetus* Cope.

Homorophus insuetus Cope

Homorophus insuetus, Cope, Proc. Amer. Philos. Soc., xi, 1870, p. 552; Ibid., xii, 1871, p. 44; Vert. Cret. Form. West, 1875, p. 263.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 446.

The type of this species appears to be lost. It was discovered in the uppermost bed of Cretaceous greensand, at Pemberton, Burlington County, New Jersey. Cope does not state what parts of the shell he had, but he describes some neural bones, the entoplastron, the hyoplastron, the hypoplastron, and some costals. He had neither the epiplastra nor the xiphiplastra.

The hyoplastron and the hypoplastron together measured 200 mm. along the midline. On comparing these parts of the plastron with the same parts in *Baptemys* it is concluded that the plastron had a length of about 420 mm.

The sutures bounding the neural bones appear to have been obscure. Cope says that one of the neurals was 14 mm. thick, 60 mm. long, 28.5 mm. wide in front, and 91 mm. wide behind. It is possible that there was here some error in observation or in statement. On the visceral face the neurals were very narrow, but they expanded, so that a transverse section resembled that of a broad wedge with truncated apex. The vertebral scutes had a remarkable form. For the most part, they were narrower than the neural bones. One is described as having the front coffin-shaped, the lateral margins concave, and the posterior end expanded, so that the scute was fiddle-shaped. The anterior vertebral is stated to have been 60 mm. long and 35 mm. wide anteriorly. The posterior costal scutes are described as meeting in the midline behind.

The thickness of the hyoplastron was 15 mm. The free border of the hypoplastron was thinned to an edge.

Genus ALAMOSEMYS nov.

Differs from *Adocus*, so far as known, in having the marginal scutes wholly excluded from the costal bones.

Type: *Alamosemys substricta* Hay.

The generic name is derived from the name of the stream where the type was found.

Alamosemys substricta sp. nov.

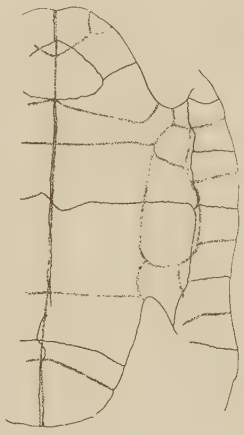
Plate 39, figs. 1, 2; text-figs. 323, 324.

The specimen which serves as the type of this species was collected in the Torrejon deposits of New Mexico, near the head of Alamosa Creek, in 1896, by Dr. J. L. Wortman and Mr. W. Granger. It bears the catalog number 1204, in the American Museum.

The specimen is a complete shell, extremely little damage having been done to either the carapace or the plastron through loss of any part. Unfortunately, however, an extremely compact clayey limestone has envelopt the shell, and this clings so closely to the bone that it was very difficult to remove it. In addition to this, there had been deposited over considerable portions of the shell scattered nodular masses of hematite, which became so thoroly attacht to the bone that, in removing them, the surface of the bone was somewhat injured. This condition has resulted in making it very difficult to determine the position and courses of some of the sutures between the bones, and likewise the impressions between the different epidermal scutes. Many of the bone sutures could be determined only by removing, by means of hydrochloric acid, a thin layer of bone so that the matrix in the sutures projected a little. The obdurate nature of the matrix which fills the shell has seemed to render it inadvisable to attempt to remove it for the purpose of seeing characters found on the inside of the shell.

The specimen has been carefully studied and the various sutures and sulci have been represented in the figures herewith provided. As to the bone sutures, they have been satisfactorily made out and may be relied upon. Many of the epidermal sulci have been more difficult to determine; but in general, it is believed that they are correctly mapt.

323.



324.

FIGS. 323 AND 324.—*Alamosemys substricta.* Carapace and plastron of type. $\times\frac{1}{8}$.

323. Carapace. 324. Plastron.

The carapace (plate 39, fig. 1; text-fig. 323) is elongated, moderately elevated, decidedly constricted at the inguinal notches, and with the peripherals behind these somewhat flaring. A remarkable feature of the shell, shared by *Adocus*, is the large part of it which lies behind the sutures separating the third and fourth costal plates above and that which separates the hyoplastrals from the hypoplastrals. Sixty per cent. of the length lies behind the line indicated. So far as known to the writer, this is approacht only in *Chelydra* of living genera. Nearly half of the entire length lies behind the inguinal notches.

In front, over the neck, there is an emargination in the border of the shell, while there are some feeble serrations in the hinder border. The extreme length of the carapace, in a straight line, is 550 mm. The greatest width, 380 mm., is just behind the inguinal notches; between the third and fourth costals the width is 372 mm. The greatest depth of the shell is 150 mm., but in life this may have been greater. On each side of the middle line of the carapace, for some distance, the shell is flat, there being no suggestion of a keel. The nuchal bone is 55 mm. long in the midline; its lateral extent is 53 mm. at the anterior margin; 90 mm. where widest. There are 7 neurals. The eighth was wholly suppresst; the sixth and seventh were reduced in size and crowded forward. The first is broadly oval, 57 mm. long and 32 mm. wide. The second is narrowly oval, 44 mm. long and 18 mm. wide; the third, fourth, and fifth are hex-

agonal, with the broader end forward; the third being 56 mm. long and 25 mm. wide; the fourth, 46 mm. long and 22 mm. wide; the fifth, 38 mm. long and 22 mm. wide. The sixth is hexagonal, 20 mm. long and 28 mm. wide. The seventh neural is pentagonal, 22 mm. long and 17 mm. wide. It has the appearance of having been crowded far forward out of its place. There is a single broad suprapygal whose length is 46 mm. and width 100 mm.

The members of the sixth, seventh, and eighth pairs of costals respectively meet along the midline. The suture between those of the eighth pair is 82 mm. long. The peripherals are unusually high, about 100 mm. along the sides; somewhat less toward each extremity of the animal, the first and eleventh being about 64 mm. high. The free peripherals are thin at the borders, and the hinder ones are reduced to a sharp edge. The thickness of the second peripheral, near the upper border, is 20 mm.; that of the ninth, at the upper border, is 16 mm. There are 11 of these peripherals on each side.

As stated, it is difficult, in a few cases impossible, to determine satisfactorily the boundaries of the epidermal scutes. In front there is a very narrow nuchal, about 10 mm. wide and 20 mm. long. This is followed by a first marginal, 58 mm. along the front edge and 30 mm. fore and aft. The sulci between the marginals and the costal scutes appear to run at a considerable distance below the sutures between the costal and peripheral bones, the marginals being about 75 mm. high. The limits of the vertebral scutes are satisfactorily determined, except those of the fifth. The first vertebral is 80 mm. long and 130 mm. across its anterior end. The second is 100 mm. long and 65 mm. wide; the third 90 mm. long and 66 mm. wide; the fourth apparently 108 mm. long and close to 58 mm. wide. The fifth was probably 115 mm. long and about 130 mm. wide.

The surface of the carapace, including the lower faces of the peripherals, is ornamented with narrow and low longitudinal wrinkles of which there are from five to eight in a 10 mm. line. They are possibly due to the great age of the specimen and may be wanting in the younger individuals.

The plastron (plate 39, fig. 2; text-fig. 324) is well developt, altho it leaves wide spaces between it and the carapace. It was apparently quite flat, altho now somewhat concave transversely, the result possibly of pressure. The total length is 415 mm. The anterior lobe projects nearly as far forward as the anterior border of the carapace; but the hinder fails to extend as far backward as the carapace by about 115 mm. The anterior end of the plastron is very slightly emarginated; the posterior end is broadly rounded and without notch.

The length of the anterior lobe is 100 mm.; its width at the axillary notch 209 mm. It decreases in width gradually at first, then rounds rapidly to the notch in front. Its thickness near the front is 9 mm. The length of the posterior lobe is 132 mm.; its width at the inguinal notches is 190 mm. The bridge is 180 mm. in width. The axillary and inguinal buttresses do not appear to extend inward beyond the adjacent borders of the plastron.

The entoplastral bone is short and broad and with a nearly straight hinder border. Its length is 55 mm; its width, 90 mm. The hyoplastral bones meet along the midline for a distance of 100 mm. The suture separating the hypoplastrals from the xiphiplastrals is believed to be placed as shown in the figures. The former bones occupy 135 mm. of the midline; the latter, 84 mm.

Gular and intergular scutes seem to be present and to have the positions and forms given them in the figures. The intergular area is evidently divided by a median sulcus. The two taken together are 75 mm. wide and 50 mm. long. The gulars are small, triangular, and widely separated by the intergulars.

The humero-pectoral sulcus crosses the midline at the hinder end of the entoplastron. The humerals meet on the entoplastron for a distance of 48 mm. The pectorals extend along the midline only 46 mm. Altho the femoro-abdominal sulcus is not as distinct as might be desired, it is probably placed correctly in the figures. The abdominals thus have a fore-and-aft extent of 128 mm. The femorals extend along the midline 80 mm.; the anals, 67 mm.

On the bridges of the plastron there are at least four inframarginals. Of these, the one in front is small and square; the second, pentagonal; while the fifth is probably hexagonal. The third is 95 mm. long and 42 mm. wide, and may possibly be subdivided; but no sulcus is visible.

The surface of the bones of the plastron appears, for the most part, to have been smooth, but there are some indications of the same kind of wrinkling, or folding, as is seen on the upper surface. This is especially the case on the bridges and lower ends of the bridge peripherals.

Genus HOPLOCHELYS nov.

Shell thick and solid. Peripherals united to the plastral bones by means of digitations and dentated sutures; with the costals by gomphosis and in addition by simple apposition or sutures. Carapace furnisht above with three carinæ. Plastron with anterior lobe immovable and with the posterior lobe narrow.

Type: *Chelydra crassa* Cope.

The characters of this genus are derived wholly from the shell. The plastral structures are not well known in any of the species. The genus appears to be related to *Staurotypus* now living in Central America. The latter possesses only 10 peripheral bones on each side. It appears not improbable that *H. saliens* and *H. paludosa*, having the peripherals sutured to the costals, really belong to a distinct genus.

Hoplochelys crassa (Cope).

Plate 38, figs. 4–9; text-fig. 325.

Dermatemys sp., Cope, Proc. Amer. Philos. Soc., xx, 1882, p. 461 (no description).
Chelydra crassa, Cope, Science (1), xi, 1888, p. 198 (no description); Trans. Amer. Philos. Soc., (2,) xvi, 1888, p. 306.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 446.
Hoplochelys crassa, Hay, Amer. Geologist, xxxv, 1905, p. 339.

Professor Cope's first description of this species appeared in the Transactions of the American Philosophical Society as cited above; but he had previously mentioned it, as early as the year 1882, as a species of *Dermatemys*. In no place does this author state the exact locality or level at which the specimens were found by his collector, Mr. David Baldwin. However, Cope's label, which accompanies the type specimen, states that it was found June 6, 1883; and Dr. W. D. Matthew has been able to show from the labels found with the mammals collected by Mr. Baldwin that at that time the collector was in the neighborhood of Chaco Canyon, San Juan County, New Mexico. Both the Puerco and the Torrejon are found in that region and it is therefore uncertain to which of these the fossil belongs. Two other species referred to the genus come from the Torrejon. Cope's first mention of the species in 1882 was doubtless based on other specimens, possibly the three neurals of which he speaks in his description.

Cope states that he possest remains of 2 individuals. Of the first there were present 2 vertebral bones, 9 peripherals, and 3 plastrals; of the second, 3 vertebrals. The bones of the first-mentioned individual are now in the American Museum of Natural History and bear the catalog number 6091; where the remains of the second specimen are is not at present known.

Of the 9 peripherals in Professor Cope's possession 4 are represented by only as many fragments. No neurals are present, but there are 2 fragments of costal plates (plate 38, fig. 8), which are not mentioned by Cope; unless, indeed, they were mistaken for neurals. A study of the materials at hand has convinct the writer that Professor Cope was nearer the truth when he regarded this species as a *Dermatemys*.

As stated, no neural bones are preserved. The presence of a median keel must rest on Cope's statement and on the probability that such a keel would accompany the lateral keels. The latter were sharply defined (plate 38, fig. 8) and ran longitudinally at a distance of about 10 mm. from the median border of the costal scutes. Along this keel, on the hinder portion of the costal scute represented, the crest rises but little above the surface of the bone; but immediately behind the sulcus that separates this scute from the next one there is a sudden depression of the bone, so that the keel stands up very prominently. As it is followed backward its apparent height diminishes. Where the sulcus crosses the keel the sulcus bends forward, then again backward, thus forming a sort of loop. One of the costals present is 20 mm. wide, the other is 18 mm. The thickness through the keel is 6 mm., but this rapidly diminishes to about 3 mm. distally. The width of the vertebral scutes can not be determined.

It appears probable that the back of this species resembled closely that of *Staurotypus triporcatus*, as represented on plate XXB of Gray's Catalogue of Shield Reptiles.

None of the peripheral bones at hand show that there was a dentated suture between them and the costals. Those which articulated with the plastron are thick and heavy. Of these there were probably 5 on each side. Plate 38, figs. 4, 5, represents one which is regarded as the sixth peripheral of the right side. It is slightly larger than the corresponding one of the left side. The length is 22 mm.; the thickness of the hinder end, 17 mm.; that of the anterior end, 10 mm. The outer surface is strongly convex, and furnisht with a longitudinal sharp ridge. The anterior portion of the inner surface is concave. Along the lower border of this face are three excavations for digitations from the hypoplastron. Near the upper border is a deep cylindrical pit for the extremity of a rib. The hindermost digitation of the hypoplastron has evidently past on to the next peripheral behind, probably the seventh. Other thickened peripherals present almost certainly belonged farther forward and received the digitations of the hyoplastron. Between these and the thickened peripheral just described there was at least 1, probably 2, thinner peripherals. One of these, the fourth or the fifth, is represented by figs. 6 and 7 of plate 38. Its length is 19 mm.; its height, 27 mm.; its greatest thickness 9 mm. Its outer surface is convex perpendicularly, and is traverst by the continuation of the ridge described as occurring on the thickened peripherals. The inner surface is concave perpendicularly. In the upper half of this face is a pit for a rib-end; near the lower border are 3 shallow pits for digitations from the plastral bones. The lower edge was connected with the plastron by a dentate suture. This bone or one similar to it was connected partly with the hyoplastron, partly with the hypoplastron. Each of these peripherals is traverst by a perpendicular sulcus. Along the upper border runs a longitudinal sulcus and along the lower border another, all these forming the boundaries of the marginal scutes.

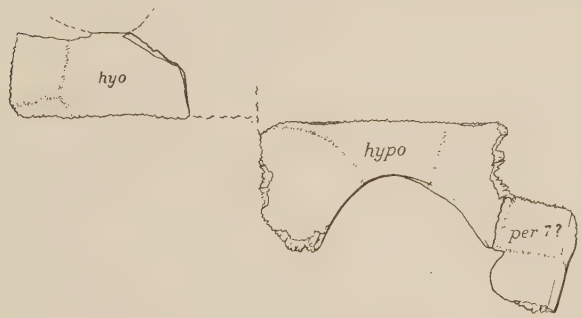


FIG. 325.—*Hoplochelys crassa*. Part of right hyoplastron, the left hypoplastron, and one left peripheral, probably the seventh. $\times\frac{2}{3}$.

Fig. 9 of the plate cited represents the pygal bone. Its length is 22 mm., its height 18 mm., its greatest thickness 8 mm. Perpendicularly the outer face is concave, the inner strongly convex. It is doubtful whether the upper border formed a jagged suture with the suprapygal. Another free peripheral, probably the tenth, resembles the pygal in general features.

Text-fig. 325 represents the left hypoplastron attacht to the seventh peripheral. Near the hyohypoplastral suture and near the midline the thickness of the bone is 9 mm.; at the outer extremity the thickness is 4 mm. At the narrowest portion the width is 11 mm. The bone was united with the one on the opposite side by a coarse suture; similarly with the xiphiplastron. With the thicker peripherals it was articulated by means of digitations; with the intermediate and thinner ones, by both digitations and dentated sutures. A process of the xiphiplastron extended along the outer, hinder angle of the hypoplastron. On the lower surface, between the outer and the middle thirds of the bone there is seen a shallow sulcus, the inner boundary of an inframarginal scute. Another sulcus begins at the inguinal notch and runs forward and inward to the meeting of the transverse and longitudinal sutures.

On the left side of the figure last cited is represented the outer two-thirds of the hyoplastron of the right side. At the narrowest part the bone was 16.5 mm. wide. The bridge was, therefore, at its narrowest portion, about 27 mm. wide. On the outer end of the bone are sulci bounding portions of 2 inframarginal scutes. No other sulcus is seen on this bone; and it is not probable that there was one beginning at the axillary notch and running backward and inward to meet the one from the inguinal notch, such as we find in *Chelydra*. The whole arrangement appears to be like that of *Staurotypus salvinii*, as represented by Dr. Boulenger in his Catalogue of Chelonians.

The xiphiplastra were evidently small bones, but there is no remnant of them preserved.

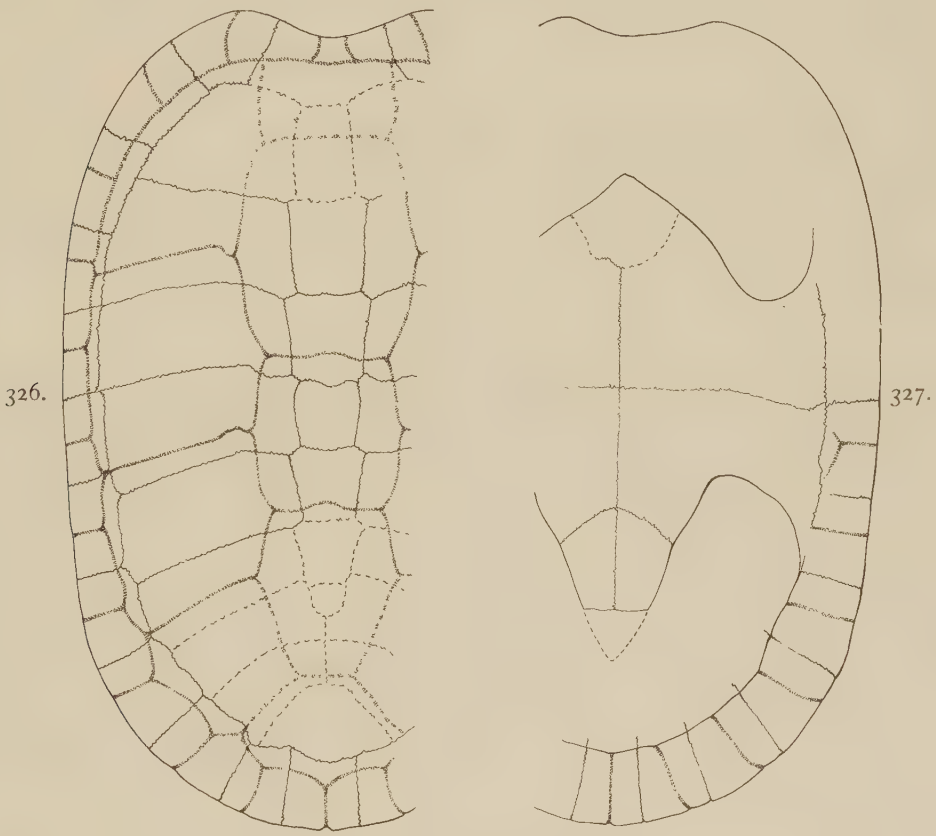
The width of the shell of this specimen was about 130 mm. An estimate based on the width of the two costal plates shows that the length was approximately 185 mm. The animal was therefore somewhat broader relatively than either *Staurotypus salvinii* or *S. triporcatus*.

So far as known, this species differs from *H. saliens* in having the bones of the plastron less firmly sutured with the peripherals and in having the latter bones, at least those of the bridge region, without close suture with the costals. The bridge is much narrower.

Hoplochelys saliens sp. nov.

Text-figs. 326, 327.

The only specimen of this species at present known was found by Dr. J. L. Wortman in 1896, at the head of the Escavada Canyon, Rio Arriba County, New Mexico, in Torrejon deposits. It belongs to the American Museum of Natural History and bears the number



FIGS. 326 AND 327.—*Hoplochelys saliens*. Carapace and plastron of type. ×⅓. Restored portions in interrupted lines.

326. Carapace. 327. Plastron and part of carapace.

1200. The shell, the only portion preserved, is considerably crusht, but is nearly all present. The only parts missing are portions of the seventh and eighth costals, the hindermost neurals, and some portions of the plastron. Unfortunately for an understanding of the structure of the shell much of it was covered by a very refractory matrix, which adhered so closely that it had to be ground away to the bone. As a result, it is difficult to determine in many places the position of the boundaries of the scutes and sometimes of the sutures. Most of the peripherals, however, have been beautifully weathered out and preserved.

In form the carapace (fig. 326) was oval, rounded in front and behind, and apparently of some considerable elevation. The total length was close to 325 mm.; the width, close to 200 mm. There was a median keel of moderate height. On each side of this, at a distance of 50

mm. in front, 30 mm. behind, there was a more prominent lateral keel. Along none of these keels was the bone suddenly sunken just behind the transverse sulci, as it is in *H. crassa*. In addition to these keels, there is on each side, on the bridge peripherals, a narrow ridge which passes in front and behind into the free edges of the peripherals.

The rim of the carapace was formed by a nuchal, probably ten pairs of peripherals, and a pygal. The nuchal is excavated in front for the neck. The width in front is 43 mm,; its thickness is 11 mm.; its length can not be determined. The first peripheral is 32 mm. long on the free border and 38 mm. high. The second peripheral is 35 mm. long, concave above, convex below, and with an acute border. Farther backward this border runs into the rather sharp keel running along near the upper border of the bridge peripherals. The upper border of the bridge peripherals is plane, continuous with the surface of the costals, and 10 mm. or less wide. At the bottom of this surface just above the keel before mentioned run the sulci separating the costal scutes from the marginals. Immediately below the lateral keel the peripherals thicken suddenly and form a sort of roll along the shell. The form of this roll may be seen from the section of the peripheral of the next species, *H. paludosa*. The peripherals behind the bridge are slightly flared upward and are acute-edged. The width and length of the pygal can not be determined. The hinder border of the carapace was not notcht.

The anterior costal plate had a width of about 50 mm.; the next 3 or 4 pairs, a width of 35 mm. or a little more. The costals opposite the bridges have a thickness of 7 mm. at their distal ends.

The neurals are broad, and with the broader end forward. The second has a width of about 35 mm.; the third about the same width; the fourth a width of 25 mm. The boundaries of those behind these can not be determined. The second vertebral scute has a width of about 75 mm.; the succeeding ones are narrower.

The anterior lobe of the plastron (fig. 327) is about 100 mm. wide at the base. It appears probable that the epiplastrals are missing. The entoplastron appears to have the form and size represented in the figures. The epiplastra were probably in contact with the outer border of the hyoplastra as in *Staurotypus salvinii* (Boulenger's Catalogue, p. 31). The bridge has a width of about 60 mm., a little more than half of which is furnisht by the hyoplastron.

The hinder lobe of the plastron is about 70 mm. wide at the base. The suture between the hypoplastra and the xiphiplastra was probably where shown in the figures, but this is not certain. The xiphiplastra probably came to a point posteriorly.

Of *Staurotypus salvinii*, Sumichrast says (Bull. Soc. Zool. France, 1880, p. 169) that it lives in muddy pools. Its food consists of small aquatic animals, especially of mollusks belonging to the genus *Ampullaria*. Its disposition is voracious and irritable. Its gait on land is free, and it runs with some swiftness, a fact due to the form of the plastron, which leaves to the limbs freedom of motion.

The small posterior lobe of the plastron of *Hoplochelys* indicates that the hinder limbs were strong and endowed with freedom of movement. Its habits and disposition may have been not greatly different from those of *Staurotypus*.

Hoplochelys paludosa sp. nov.

Fig. 328.

This species is based on a single peripheral bone, probably the seventh of the left side. It was found by Mr. Barnum Brown, in 1904, in Escavada Canyon, New Mexico, where *H. saliens* was discovered. It belongs to the American Museum of Natural History and has the number 6079. It differs from the latter species in lacking the longitudinal ridge along the convexity of the outer surface of the peripherals, and in having the suture with the costals much higher above the costo-marginal sulci. In the present species this suture is at a distance of 20 mm. above the sulcus, while in *H. saliens* it is only 10 mm. or less. The absence of the peripheral carina is regarded as an important specific character. The size of the individual has been probably slightly less than that of *H. saliens*, the length of the seventh peripheral of the latter being 35 mm.; of *H. paludosa*, 32 mm.

From *H. crassa* the present species differs in having the supposed seventh peripheral strongly sutured to the contiguous costal bone, in having no lateral carina, and in having the longitudinal sulcus at the middle of the height, instead of near the costal border.

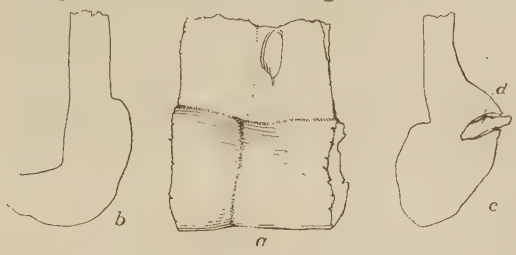


FIG. 328.—*Hoplochelys paludosa*. Supposed left seventh peripheral forming type. ×⅔. A.M.N.H.

a, bone seen from side; *b*, anterior end; *c*, posterior end; *d*, an adhering fragment of the plastron.

In the inner face of the bone are excavations for the reception of digitations from the plastron. One of these digitations remains in position, and shows that it extended backward a short distance into the eighth peripheral. The border which articulated with the costals is 7 mm. thick. In the sutural edge is a deep pit, 10 mm. in diameter, which received the extremity of the rib of the contiguous costal plate.

Fig. 328 shows the type peripheral as seen from the outside. The drawing on the right presents a view of the hinder end of the bone; the one on the left, the anterior end.

Genus KALLISTIRA nov.

Carapace thick and solid; provided with a median and two lateral carinæ. Plastron unknown, except that its inguinal buttresses were extensively developt and ascended a considerable distance against the inner surface of the fifth and sixth costals.

Type: *Dermatemys costilatus* Cope.

Kallistira costilata (Cope).

Figs. 329–334.

Dermatemys? costilatus, COPE, Syst. Catalogue Vert. Eocene, N. Mex., 1875, p. 36.
Dermatemys costilatus, COPE, Report on Geol. N. Mex., 1874 (1875), p. 96; Wheeler's Surv. 100 Merid., IV, pt. ii, p. 52, plate xxiv, figs. 17–31.
Baptemys costilatus, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445.

The types of the present species belong to the U. S. National Museum and bear the number 1152. Not all the fragments that Cope figured are present. Those missing are the originals of Cope's figs. 17, 20, 23, 24, 26, and 31. Cope states that he had fragments representing 6 individuals, and that parts of 4 were figured. There appears to be no reason for doubting that all of these individuals belonged to the same species. Figures of some portions of these types are here presented. The species was found in the Wasatch beds of New Mexico.

The species is characterized by its thick and heavy shell and the presence of at least 3 carinæ on the carapace, one running along the midline and one on each side of it.

The fragment which furnisht Professor Cope's figs. 27 and 28 belongs to the upper end of a costal, probably either the second or the fourth. Cope's fig. 27 (fig. 329) is inverted on his plate. The width of the costal is 20 mm. It is crost by a low keel whose breadth is almost 9 mm., but whose elevation is scarcely a millimeter; the thickness of the costal above the carina being 6 mm., that thru the carina, 7 mm. At the distal end of the fragment the thickness is 5 mm. This piece of costal presents a part of the sulcus bounding a vertebral scute laterally and the sulcus running down the costal. These are extremely narrow and shallow. The longitudinal sulcus is at a maximum distance of 10 mm. from the proximal border of the costal and above the lateral carina. The vertebral scutes appear to have had a width of about 42 mm. The proximal end of the costal is rounded, showing that the lateral borders of the adjacent neural were concave. Another costal, the one furnishing Cope's figs. 19 and 19*a*, belonged to a smaller individual. The carina is still less conspicuous than in the case of the one just described. The original of Cope's fig. 21 (fig. 330) has the carina more sharply defined and with a width of 5 mm. It is probable that, as suspected by Cope, the carinæ were developt on the rear of the animal and disappeared anteriorly.

Fig. 331 represents the original from which Cope obtained his fig. 30. It is a portion of the distal half of a costal, in all probability the fifth of the right side. The extreme end of the bone

appears to be missing. The figure presents the inner, or visceral, surface. This bone is 4 mm. thick at its anterior border, but toward the other border it thickens greatly, so that a little beyond the middle of the width the thickness is 10 mm. From the line of its greatest thickness the bone is beveled off on the inner side to its hinder border, and against this beveled surface the sixth costal has articulated. A strongly developt buttress from the plastron ascended against the inner surfaces of these two costals at their junction. The scar for this buttress on the fifth costal here figured is 20 mm. long. The plastron was therefore articulated with the

331. 330. 329.

FIGS. 329–331.—*Kallistira costilata*. Costals of the type. ×1.

329. Proximal end of costal, second or fourth.
330. Proximal end of costal, showing a carina.
331. Distal end of costal, probably the fifth, showing scar for inguinal buttress of plastron.

carapace in a very different way from that seen in other dermatemyds; and a distinct genus is indicated.

Portions of 3 neurals are at hand, those represented by Cope's figs. 18, 22, and 25. The first-mentioned (fig. 332) has a width of 22 mm., probably belonged well forward, and was possibly the second. The median carina is barely perceptible. No sulcus crosses the portion present. That part of a neural from which Cope's fig. 25 was drawn (fig. 332*a*) is narrow and devoid of a carina. It is crost near the fracture by a narrow and shallow sulcus. It appears quite probable that this is the posterior end of the first neural. At its lateral border it is 5 mm. thick.

The neural represented by Cope's fig. 22 (fig. 333) apparently belonged to the rear of the carapace, and resembles closely the sixth of *Staurotypus salvinii*. Its length is 18 mm.;

332. 332*a*. 333. 334. 334*a*.

FIGS. 332–334.—*Kallistira costilata*. Neurals and a peripheral of type. ×1.

332, 332*a*. Portions of two neurals of the type. 332 is Cope's fig. 18; 332*a* Cope's fig. 25.
333. A hinder neural, showing carina. Cope's fig. 22.
334. A hinder peripheral with a section (*a*) across it.

greatest breadth about 20 mm.; thickness at the lateral border 4.5 mm., through the carina 9.5 mm. The carina is sharply defined and wider in front than behind.

A portion of a hinder peripheral is present, being the original of Cope's figs. 29 and 29*a*, and constituting, according to Cope, a portion of the same individual as those furnishing his figs. 27 and 30. Cope's figure is inverted. This (fig. 334) bone has a height of 27 mm. in a direct line, and a maximum thickness of 7 mm. Its width can not be determined, as the bone has been broken near the descending sulcus. This sulcus, in contradistinction to those of the costals and neurals, is broad and deeply and irregularly imprest. Along the upper border of the bone runs what appears to be the longitudinal, or costo-marginal, sulcus. On the under

side of the bone the descending sulcus is narrow and shallow, like those of the costals. This bone is strongly concave on the upper surface and has an acute free border. It was very loosely articulated with the contiguous costal; and in the upper border there is a pit for the extremity of the costal rib. Fig. 334*a* is a section of this bone.

Professor Cope thought that this species attained about the size of *Baptemys wyomingensis*, but none of the bones described by him indicates a size so great. From the width of the costal represented by fig. 331 the writer estimates the length of the carapace at something less than 200 mm.

Genus NOTOMORPHA Cope.

A little-known genus. Anterior, and probably posterior, peripherals with obtuse free borders. Apparently intergulars large; the gulars small and removed far from the midline.

Type: *Notomorpha gravis* Cope.

The materials on which the genus *Notomorpha* was based are in the U. S. National Museum. In the original description of the genus (Proc. Amer. Philos. Soc., XII, 1872, p. 474) characters were attributed to it which were derived from bones of the species called in the present work *Echmatemys testudinea*. These bones, altho portions of the first costals with articular scars for axillary buttresses, were supposed by Cope to be xiphiplastrals with scars for the pubis. On the strength of these, the genus was assigned to the Pleurodira. Cope's discovery of his error regarding the character of the plastron, his removal of his species *testudinea* to *Emys*, and his reduction of the species *N. garmanii* to a synonym of *N. gravis*, left the latter the type of the genus. This he concluded was also a member of the Emydidæ, but associated with *Dermatemys* and *Agomphus*. As the dermatemyd turtles are now regarded as a distinct family, *Notomorpha* must be arranged in that family.

As stated above, Cope made his *N. garmanii* a synonym of *N. gravis*, a proper course in case there is only a single species involved; but of this there may be permitted grave doubts. Of his *gravis* he described a hyoplastron and an epiplastral of one individual and a costal of what was doubtfully another. The costal had a width of 58 mm., which indicated a very large turtle. Cope at first recognized important differences between the epiplastrals; but later he considered these of less importance. We may, then, have doubts regarding the specific identity of the two lots of bones. Besides this, the materials figured all belong to his *N. garmanii*.

Notwithstanding all this, until future discoveries shall have thrown additional light on *Notomorpha*, it will be best to place the few known remains under the specific name *gravis*.

Notomorpha gravis Cope.

Figs. 335, 336.

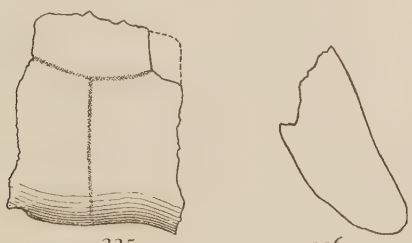
Notomorpha gravis, Cope, Proc. Amer. Philos. Soc., XII, 1872, p. 476.
Notomorpha garmanii, Cope, Proc. Amer. Philos. Soc., XII, 1872, p. 477.
Emys gravis, Cope, Sixth Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 626.
Notomorpha gravis, Cope, Vert. Tert. Form. West, 1884, p. 143, plate xxiii, figs. 14–16.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

The bones on which *Notomorpha gravis* was based appear to have been lost. Those which Cope described as *N. garmanii* are now in the U. S. National Museum, some of these bearing the number 4103; others, belonging apparently to the same individual, have the number 4129. It is not known whether all the bones accompanying the figured specimens belonged to the same individuals or even the same species. We shall have to regard as types the remains which were figured by Cope. All three of these are numbered 4103. The bones originally described under the two specific names had been discovered in the Wasatch beds at a point near Bear River, 6 miles north of Evanston, Wyoming.

The bone which was regarded as characteristic of *Notomorpha* is the supposed epiplastron, the subject of Cope's fig. 14, plate xxiii, of his work on The Vertebrata of the Tertiary Formations of the West. The writer has been unable to convince himself that this is the epiplastron, altho it may be such. It may be a first peripheral. The upper border of the original of Cope's fig. 14, which was supposed to be the front of the lip, has the appearance of having

been a sutural edge for articulation with another bone. The border between the supposed gular scutes is broken off. If the bone is an epiplastron it must once have projected considerably at this point, and the front of the anterior lobe was deeply emarginated. The length of the bone is about 40 mm.; its thickness behind is 11 mm. In case the bone is an epiplastron, the lip was about 40 mm. wide. The free border of the bone, that represented by the right side of the figure, is thick and obtuse. That of the same bone in Cope's type of *N. gravis*, as originally described, was acute. In his last description of these bones this difference appears to have been thought of no specific importance. On the supposed under side of the bone are seen distinct sulci, indicating the supposed intergulars and the small triangular gulars. If such they are, affinity with the Dermatemydidæ is indicated. Whether or not the intergular was divided at the midline we can not determine.

Fig. 335 represents the third left peripheral (No. 4129, U. S. N. M.) seen from above, while fig. 336 presents a view of the sutural end which joins the second peripheral. It is seen that the free border is obtuse. The costo-marginal sulci ran along not far below the upper margin of the bone. The bone is 39 mm. high, 36 mm. along the free border, and 18 mm. thick. Cope figures 2 peripherals, but the free borders were missing in both.



335. 336.

FIGS. 335 AND 336.—*Notomorpha gravis*. View of third left peripheral of the type, with section. $\times\frac{2}{3}$.

335. Peripheral seen from without.
336. Section at anterior end.

Cope's fig. 15 is said to represent the posterior edge of the eighth peripheral of the right side; but it belonged to the left side. This bone was somewhat recurved; its height is about 44 mm.; its length on the free border 35 mm.; its thickness about 9 mm. at the border represented. The articular border for union with the costals was thin.

The seventh peripheral (Cope's fig. 16) is stated to have been 42 mm. wide, 45 mm. high, and 15 mm. thick. This peripheral, the seventh of the left side, entered into the inguinal notch. Its free border was acute; its upper articular border was thin.

Besides these peripherals, Cope had others belonging to the bridge region. These he states had very obtuse free borders. The general massiveness of these was in contrast with the thinness of the costals. The surface of the peripherals is said to have been obsoletely rugose. A vertebral bone is stated to have been 7 mm. thick.

Genus BAPTEMYS Leidy.

Plastron united with the carapace by means of sutures and by axillary and inguinal buttresses, which rise to the lower borders of the costals or beyond. Plastral lobes short and narrow, the hinder not notcht. Nuchal bone with short costiform processes. A full set of neurals. Marginal scutes not encroaching on the costal bones. Intergulars, gulars, and humerals of each side usually consolidated into one scute. Inframarginals present.

Type: *Baptemys wyomingensis* Leidy.

This is the only genus of the Dermatemydidæ which possesses a full series of neurals. The pectoral scutes appear to have extended themselves forward to the epiplastrals and even further. The region which in *Adocus* is occupied by the intergulars, gulars, and humerals of each side presents usually only a single scute; but in a specimen of *B. tricarinata* (fig. 348) the gulo-humeral sulcus is partly developt.

This genus is represented by 3 known species. Of these, one, *B. fluviatilis*, comes from uncertain locality and level. Of the others, *B. tricarinata* belongs to the Wind River beds, while *B. wyomingensis* is common in the Bridger beds of southwestern Wyoming.

Baptemys wyomingensis Leidy.

Plate 37, figs. 11–13; plate 38, fig. 10; plate 40, fig. 1; plate 41, figs. 1, 2; text-figs. 337–345.

Baptemys wyomingensis, LEIDY, Proc. Acad. Nat. Sci. Phila. 1870, p. 5; Ann. Report U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 367; Ann. Report U. S. Geol. Surv. Montana, etc., 1872, p. 367; Contrib. Ext. Fauna West Terrs., 1873, pp. 157, 340, plate xii, plate xv, fig. 6.—COPE, Ext.

Batrach. Reptilia, Aves N. A., 1869 (1870), p. ii.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 445; Amer. Jour. Sci. (4), XVIII, 1904, p. 265, plate xiii, figs. 1–3, text-fig. 2; Amer. Geologist, XXXV, 1905, p. 331.

Adocus vyomingensis, COPE, Ext. Batrach., Reptilia, Aves N. A., 1870, p. 233; Proc. Amer. Philos. Soc., XI, 1870, p. 297.

Dermatemys wyomingensis, COPE, 6th Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 624; Amer. Naturalist, XVI, 1882, p. 991, fig. 9.

Dermatemys vyomingensis, COPE, Vert. Tert. Form. West, 1884, p. 142.

Baëna ponderosa, COPE, 6th Ann. Report U. S. Geol. Surv. Terrs, 1872 (1873), p. 624.

Baëna? ponderosa, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1903, p. 438.

The type of the present species belongs to the Academy of Natural Sciences at Philadelphia. The specimen was obtained somewhere in the neighborhood of Fort Bridger, Wyoming, from which locality probably all the known specimens have been derived. The level is therefore that of the lower portions of the Bridger beds. Of the type, some of the peripherals are missing, also the front of the plastron. The total length of the carapace in life was nearly 450 mm.; the breadth, about 310 mm. On the hinder third of the carapace there is a prominent carina, the summit of which is flat. The anterior neurals are considerably longer than wide, with the broader end directed forward. The free borders of the anterior peripherals are thickened and obtuse. The surface of the carapace is mostly smooth, but posteriorly somewhat corrugated. The dimensions of the vertebral scutes are given in the table.

Vertebrals of type.			Neurals of 1494 A.M.N.H.			Vertebrals of 1494 A.M.N.H.		
No.	Length.	Width.	No.	Length.	Width.	No.	Length.	Width.
1	81	108	1	50	22	1	68	90
2	104	62	2	42	22	2	85	53
3	90	68	2	45	21	3	83	55
4	79	66	4	40	22	4	86	60
5	..	..	5	42	23	5	110	104
			6	37	28			
			7	25	28			
			8	17.5	27			

The plastron is relatively small, and large spaces are left between it and the carapace, thus favoring the movements of the legs. The anterior lobe is 148 mm. wide at the base. The bridge has a width of 105 mm. The hinder lobe terminates obtusely behind. The length is 94 mm.; the width at the base, 115 mm. On each of the bridges are 3 inframarginal scutes. Of these the hindermost extends forward on the hyoplastron.

Dr. Leidy described a second specimen which had been discovered at Church Buttes. This shell was important because it furnisht the front of the plastron, which Leidy figured in his Contributions (plate xv, fig. 6). This front, however, differs so much from that of all others found since, that there is some reason for suspecting that it belongs to a distinct species, being truncated and notcht in front. Below some details are given regarding this specimen.

In the Cope collection belonging to the American Museum of Natural History is a large specimen which presents the carapace (plate 40, fig. 1; text-fig. 337); but of the plastron there is only the impression of the hinder lobe on the matrix. The catalog number is 1494. Were it not that Cope describes the form of the anterior lobe, it might be supposed that it is the specimen mentioned by him in the Proceedings of the American Philosophical Society (vol. XI, p. 297). It is possible that that author did not intend to state that his specimen possest this lobe, but referred to what Dr. Leidy had determined. The total length of the carapace is 435 mm., in a straight line; the width is 283 mm.; and the height, about 180 mm. The specimen is remarkable for its narrowness. The anterior edge is thickened and rounded like the edge of one's little finger. The thickness of the first peripheral is 16 mm. The hinder free borders are also obtuse, but much thinner, the thickness near the edge of the tenth being 7 mm.; but this increases to 14 mm. at half the height of the bone. The neurals are narrow. The dimensions of the neurals and the vertebral scutes are presented in the table above.

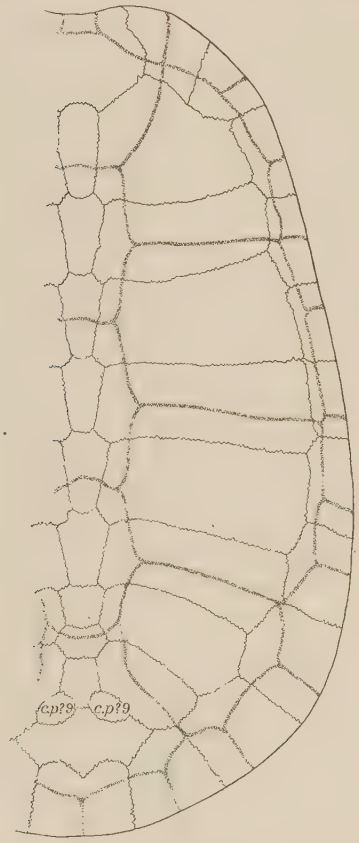
There are 12 pairs of marginal scutes. The costo-marginal sulcus runs considerably below the costo-peripheral suture. There appears to be present a ninth pair of costal plates (fig. 337, *c.p.*? 9).

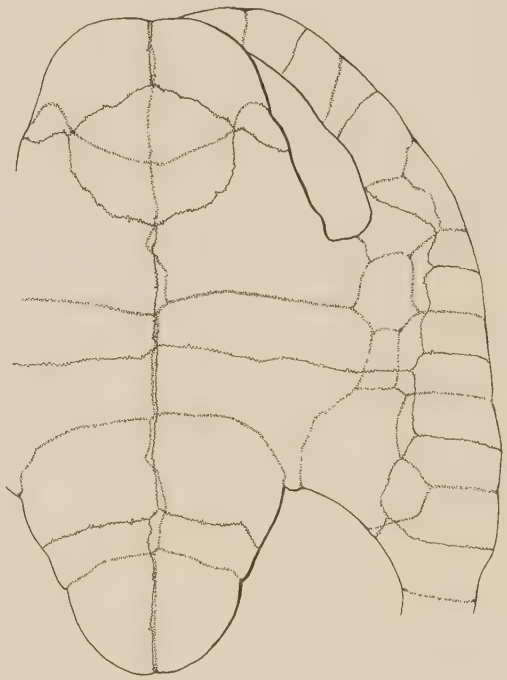
The American Museum expedition of 1903 secured 2 specimens of this species at Grizzly Buttes. These have the catalog numbers 5934 and 5967. No. 5967 presents a large portion

of the skull. The shell of both specimens is quite complete. In neither is the front of the plastron truncated. The length of the carapace of No. 5967 (plate 41, figs. 1, 2) was originally close to 430 mm.; its width about 330 mm.; but the shell has been strongly crusht downward. The first vertebral scute has a width anteriorly of 80 mm.; the next three, each a width of about 56 mm.; the fifth, a width of 128 mm. posteriorly. It will be observed that the last of these vertebrals is considerably wider than in the Cope specimen. On the hinder half of the carapace there is seen, on each side of the vertebral scutes, an indistinct flattened carina. These correspond to the much more prominent lateral keels seen in the predecessor of this species, *B. tricarinata*.

The anterior lobe of the plastron is 100 mm. long and 152 mm. wide at the base. The lateral borders converge in nearly straight lines to opposite the front of the entoplastron; then they round rapidly to the midline. The entoplastron is large, 62 mm. long and 67 mm. wide. The bridge is 117 mm. wide. The hinder lobe is 92 mm. long and 130 mm. wide at

337.





338.

FIGS. 337 AND 338.—*Baptemys wyomingensis*. Carapace and plastron.

337. Carapace. $\times\frac{1}{4}$. No. 1494 A. M. N. H. *c. p.* 9, probable ninth pair of costal bones.
338. Plastron and border of carapace. $\times\frac{7}{25}$. Specimen in Yale University.

the base. As in other known specimens, the intergulars, gulars, and humerals appear to have coalesct. The humero-pectoral sulcus crosses the entoplastron a little behind its middle, and on the hyoplastron it turns abruptly forward and outward. The anal scutes measure 51 mm. on the midline. Each of the other pairs measure about 62 mm. On each bridge there are 3 inframarginals, as in the type of the species. The hindermost one is 110 mm. long on its outer border.

The specimen numbered 5934 differs from the one just described in having the first vertebral scute unusually wide, 125 mm. The lateral borders of the anterior lobe of the plastron are not so straight as in No. 5967 and the extremity is slightly more pointed. The inframarginals are as in the latter. This specimen shows well the buttresses. The axillary

bones ascend to the borders of the first costals. The inguinal buttresses do not reach the upper borders of the peripherals.

At Yale University is a specimen (No. 484) which was collected in 1870, at Millersville, Wyoming, therefore in the lower third of the Bridger deposits. It furnishes a crusht carapace and a complete plastron (text-fig. 338), the nearly complete skull (plate 37, figs. 11, 12, 13), and portions of limb bones. The carapace has a length of 445 mm. and a width of 330 mm. There is a large suprapygal 45 mm. long and 70 mm. wide. The first vertebral scute is 100 mm. wide; the second, 52 mm.; the third, 50 mm.; the fourth, 66 mm.; the fifth, 95 mm. Besides these normal vertebrals there is a small supernumerary one, 37 mm. long, cut off from the front of the normal fifth. The plastron (fig. 338) is 305 mm. long. As will be seen from the figure, there are on each bridge 4 inframarginals. A small one appears to have been cut off from the anterior end of the large third one of other specimens. In this specimen the anterior extremity of the plastron comes forward as far as the front of the carapace; but this is doubtless due to crushing.

A specimen at Princeton University, No. 10074, is half as high as long.

Dr. Leidy's second specimen, the one which furnisht the truncated anterior lobe of the plastron, is in the U. S. National Museum and has the number 5000. In all respects, except the form of this lobe, the specimen agrees with typical specimens of *B. wyomingensis*. The plastron alone is represented and of this a portion of the hinder lobe is missing. The length of the anterior lobe is 93 mm.; its width at the base 145 mm.; width at the epiplastral sutures, 114 mm. The entoplastron is 76 mm. long and 64 mm. wide. The width of the bridge is 108 mm. The hinder lobe has a width of 108 mm., diminishing in a curve to a width of 96 mm. at the hypoxiphiplastral sutures.

Materials for the study of the skull are furnisht by the specimen at Yale University, bearing the number 484 (plate 37, figs. 11, 12, 13), and by number 5967 of the American Museum of Natural History (plate 38, fig. 10). Each of these skulls is accompanied by its shell. There appear to be no specific differences between them. The Yale skull is nearly complete, the only portions missing being the roof of the orbits and of the nasal cavities. The American Museum specimen supplies the parts missing in the Yale skull; but it is defective in many respects. That at Yale furnishes the description here given, unless otherwise specified.

Relatively to the size of the shell the skull is small. It is broad behind and tapers forward to a rather narrow snout. The length, from the snout to the occipital condyle, is 67 mm.; to the extremity of the supraoccipital spine, 88 mm. The greatest width, taken at the upper borders of the tympanic cavities, is 58 mm. The temporal region is not rooft over, and there is no parieto-squamosal arch. The postorbital arch is slightly more than 7 mm. wide. The zygomatic bar is deeply excavated on its lower border, and is 10 mm. wide. At the hinder border of the orbit, where the maxilla joins the jugal, the former bone is only 5 mm. wide. The interorbital space, as shown by the American Museum specimen, has a width of 23 mm. The orbits are placed well forward. The antero-posterior diameter of each was about 20 mm.; the perpendicular, 17 mm., the latter dimension being furnisht by the American Museum specimen. This individual also shows that the nares had a perpendicular diameter of 11 mm., a transverse diameter of 16 mm. The upper jaw is convex on its lower border, rising in front so as to form a median notch. This upper jaw, as shown especially by the American Museum specimen, has a sharp cutting-edge, but no masticatory surface. This appears to be an indication that this animal was not accustomed to crush shells, or other hard substances, but to live on more active prey.

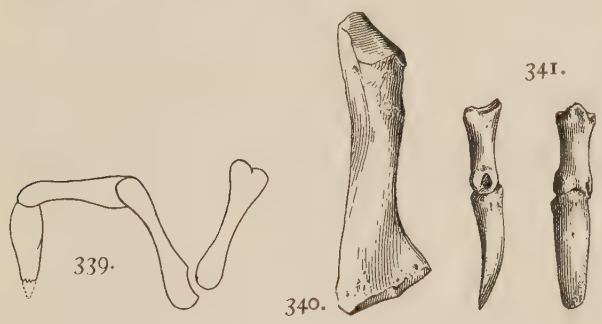
The tympanic cavity has the longest diameter directed upward and slightly backward; its outer rim is thick and heavy. The posterior wall is open, forming a notch for the passage of the stapedial rod. The sutures between the bones of the skull are close and some are to be traced only with difficulty. There seem to have been no nasals. As shown in the skull belonging to the American Museum, the prefrontals run backward over the orbits and join the postfrontals, excluding the frontals from the boundary of the orbit. From the individual just mentioned the postfrontals are missing, but the sutural borders of the frontals and of the parietals articulating with the postfrontals are well preserved. The jugal is a bone of considerable length, and it forms a large part of the lower border of the orbit.

The choanæ are far forward. The roof of the mouth in front is vaulted, not greatly unlike that of a *Testudo*. The vomer apparently extended between the palatines to the pterygoids or very close to them. The distance across the palatines, at their hinder ends, is 20 mm. The distance across the constricted portion of the pterygoids is 13 mm. There are posterior palatine foramina. The lower jaw, as shown by the American Museum specimen, had a single sharp cutting-edge, which workt against that of the upper jaw. The lower jaw appears to have formed a beak in front. The symphysis is short, about 12 mm. in length. The jaw is 20 mm. high at the coronoid region.

The right humerus is present in the Yale specimen, and complete except that the radial tuberosity is broken off. The length from the proximal surface of the head to the distal end is 83 mm. The greatest diameter of the head is 21 mm. The ulnar tuberosity is as large as that of *Chelydra*. The angle between the two tuberosities is nearly the same as in *Chelydra*. The ectepicondylar foramen also resembles that of the genus just named. The distal articular surface appears to have been bent toward the palmar surface more than in *Chelydra*. The ulna is like that of *Chelydra*, but is, relatively to the length of the humerus, longer than in the genus named. It is likewise thicker from the dorsal to the palmar surface. The length is 55 mm.; the least breadth, 8 mm. The distal end is 19 mm. wide. The dorsal surface is strongly markt by ridges for the attachment of muscles. About two-thirds of the radius is preserved.

Some portions of the hinder limbs are preserved, wholly or partly; but they have not been completely removed from the matrix. The right astragalo-calcaneum was found in the right axillary notch. It resembles that of *Chelydra*, but has the fibulare co-ossified with it.

The vertebra are represented by portions of two cervicals, but they furnish us little information. One lies against the head of the humerus and presents a cup-shaped articular cavity. The centrum is 19 mm. wide, and there is a sharp median carina on its lower surface. One complete toe is present (fig. 339). It was found in the right axillary notch; but from the length of the phalanges and the fact that the right astragalo-calcaneum was found close to it, it is concluded that it is one of the digits of the hinder limb.



FIGS. 339–341.—*Baptemys wyomingensis*. Limb bones.

339. Digit belonging to specimen of fig. 338. ×1.
340. Ulna. ×⅔. No. 5934 A. M. N. H.
341. Terminal and penultimate phalanges. ×⅔. No. 5934 A. M. N. H.

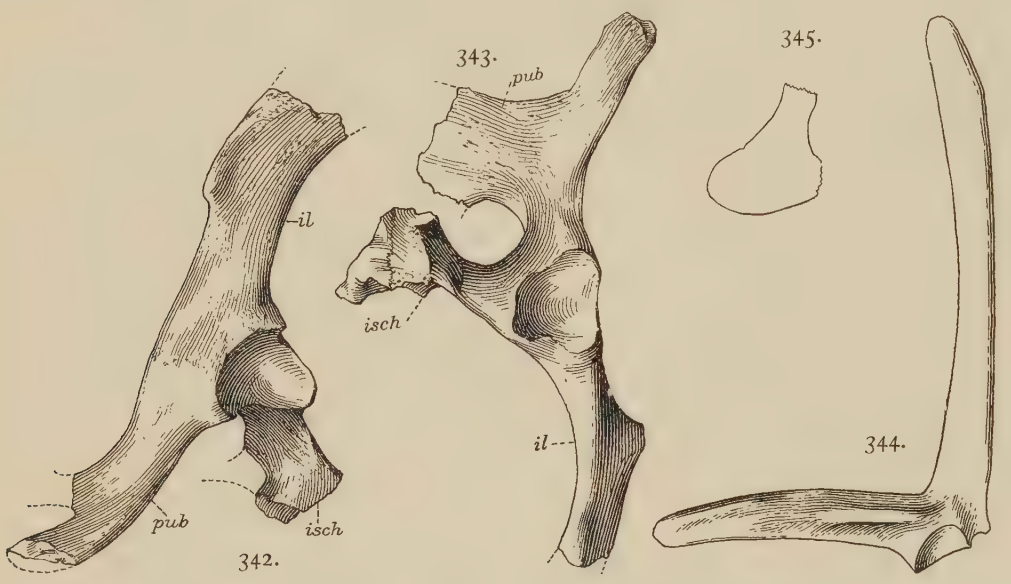
No. 5934 of the American Museum furnishes some fragments of the cervical vertebræ. One of these, a posterior one, shows that on the under side of the centrum there was a sharp and prominent carina. The anterior end of the centrum has right and left articular cavities. A posterior caudal has the centrum 17 mm. long. The total height of the centrum and the arches is 23 mm. The centrum is procœlous. The ulna is represented by fig. 340. It resembles that of *Chelydra*, but it is relatively broader and the radial border is thicker. Fig. 341 represents an ungual phalanx and the one preceding it. A considerable portion of the pelvis is preserved (figs. 342, 343). The upper end of the ilium is missing, but it was probably not broadened. On its anterior border, half the height above the acetabulum, is a strong process directed outward and forward. The pelvis resembles that of *Testudo*. The ischial symphysis is 13 mm. thick. There is a long antero-lateral pubic process. The pubic symphysis was more than 23 mm. long.

Dr. Leidy's second specimen, in the U. S. National Museum, furnishes the right scapula. This is represented as seen from behind and of two-thirds the natural size by fig. 344. The height of the body above the glenoid fossa is 102 mm; the proscapular process is 54 mm. long.

Professor Cope described from Ham's Fork, Wyoming, a species which received the name *Baëna ponderosa*. The specimens are now in the U. S. National Museum, at Washington, where the writer has twice examined them. Cope states that his figures are three-fifths the size of nature; but the measurements show that they are only half that size. Cope's fig. 5 represents the first and second right peripherals. The suture between the two is not well

shown in the figure. His fig. 4 represents the second left peripheral. Fig. 8 is from a portion of the left first costal and its median notch fits accurately on the upper border of the original of his fig. 4. Cope's fig. 6 is almost certainly that of the right third peripheral. In the collection there are present the left second and third peripherals of another individual. These bones certainly do not belong to any species of *Baëna*. They closely resemble those of *Baptemys wyomingensis*, and in all probability belong to that species.

Cope's assignment of these bones to *Baëna* was determined by the bone represented by his fig. 3. It is indeed very peculiar. Fig. 345 represents a section. Cope regarded it as form-



FIGS. 342–345.—*Baptemys wyomingensis*. Pelvis, scapula and peripheral.

342. Pelvis, from left side. ×⅔. No. 5934 A. M. N. H. *il*, ilium; *isch*, ischium; *pub*, pubis.
343. Pelvis of individual of fig. 342. Seen from below. ×⅔. *il*, ilium; *isch*, ischium; *pub*, pubis. The suture between the right and left pubes ran from a point 2 mm. on the left of the leader from *pub* backward to a point 2 mm. on the left of the line of two short dashes.
344. Scapula. ×⅔. Specimen in U. S. N. M.
345. Section of peripheral described by Cope as that of *Baëna ponderosa*. ×½.

ing a part of the hinder border of the carapace, the scute seen on it being the hindermost one. However, the writer has found in the collection another fragment which continues the border 5 or 6 mm. toward the left, and on it begins another marginal scute. It is the writer's conclusion that this bone also belongs to *Baptemys* and is a malformed portion of the hinder border of the carapace.

Baptemys tricarinata sp. nov.

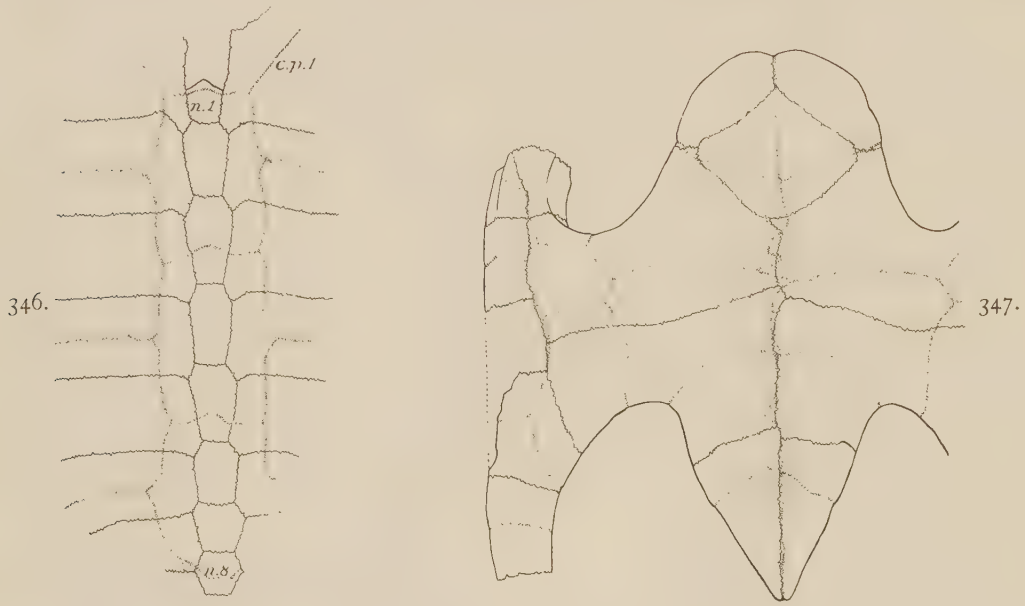
Figs. 346–349.

Dermatemys——, COPE, Bull. U. S. Geol. and Geog. Surv. Terrs., VI, 1881, p. 184.

Remains belonging to 2 individuals of the present species were collected in the Wind River deposits, during the summer of 1905, by the expedition in charge of Mr. Walter Granger, of the American Museum of Natural History. One of these, No. 6109, was found at the mouth of Alkali Creek, Fremont County, Wyoming; the other, No. 6110, on the divide between Alkali and Poison Creeks. No. 6109 is made the type of the species. Both specimens are considerably fractured, neither of them furnishing a complete carapace. Taken together, however, the two specimens give practically the whole structure of the shell. The species is distinguisht from *B. wyomingensis* by the possession of three dorsal carinæ and a pointed hinder plastral lobe.

The carapace of No. 6109 (fig. 346) has an approximate length of 460 mm.; a width of about 330 mm. Its structure differs only in minor points from that of *B. wyomingensis*. The neurals are long and narrow. The peripherals differ little from those of the Bridger species,

except that they, like the other bones of the carapace, appear to be somewhat thinner. The vertebral scutes are perhaps relatively a little wider than in *B. wyomingensis*. There are 3 broad dorsal carinæ—a median and two lateral. The median may be traced farther forward than in *B. wyomingensis*, as far forward as the front of the third neural. The lateral carinæ run just outside of the vertebral scutes. They are of moderate height posteriorly; on the



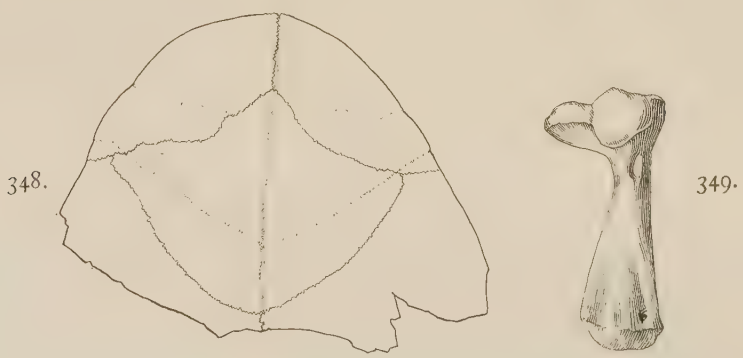
346. 347.

FIGS. 346 AND 347.—*Baptemys tricarinata*. Carapace and plastron of type. ×¼.

346. Portion of carapace. *c. p.* 1, first costal plate; *n.* 1, *n.* 8, first and eighth neurals.
347. Plastron and portion of carapace.

anterior half of the carapace they may be traced to the first costal; but on the three anterior costals they form very low ridges.

Fig. 347 represents the plastron. The total length is 285 mm. The anterior lobe is broad, rounded, and slightly notcht in front. The length is 92 mm.; the width at the base, 148 mm. The entoplastron is larger than in *B. wyomingensis*, being 65 mm. long and 75 mm. wide. The



348. 349.

FIGS. 348 AND 349.—*Baptemys tricarinata*. Plastron and humerus of type. ×½.

348. Anterior lobe of plastron. 349. Right humerus.

bridge is 93 mm. wide, relatively narrower than in the Bridger species. The hinder lobe is 105 mm. long and 111 mm. wide at the base. The sides converge backward to a point.

The scutal areas are represented in fig. 347. No gulars are markt out; but there is a notch in the border of the epiplastron, as if for the crossing of the gulo-humeral sulcus. There are on each bridge 3 inframarginals like those of most specimens of *B. wyomingensis*.

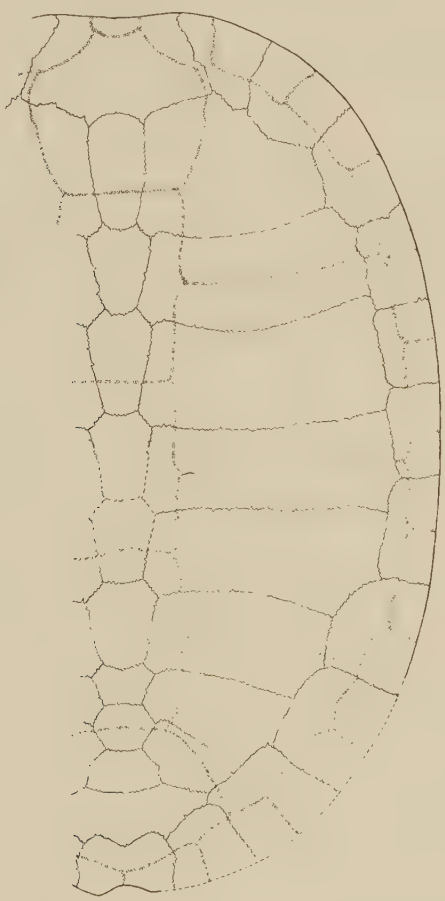
No. 6110 has been a slightly smaller individual. Fig. 348 represents the front lobe of the plastron. It is somewhat more pointed in front than that of the type. What is most interesting is the presence of portions of the gulo-humeral sulci. The extent and position of these are shown in the figure. The presence of these indicates that there has occurred in this genus a coalescence of the gulars and the humerals.

Fig. 349 represents the right humerus seen from the dorsal surface. The general form is that of the humerus of *Chelydra*.

Baptemys fluviatilis sp. nov.

Plate 42, figs. 1, 2; text-figs. 350, 351.

This species is based on a chelonite which was presented to the American Museum of Natural History by Mr. Sidney Dillon, of New York City, in 1879. It is said to have been obtained by him in Colorado, but there is no record of the exact locality, nor of the formation



350.

351.

FIGS. 350 AND 351.—*Baptemys fluviatilis*. Carapace and plastron of type. $\times\frac{1}{4}$.

350. Carapace. Restored costal and vertebral scutes indicated by interrupted dotted bands. 351. Plastron.

from which it was derived. The specimen probably belongs to the Bridger formation and there may be some error regarding the region.

The specimen consists of a mass of gray sandstone, broken into two pieces, which bears considerable portions of the carapace and impressions of other portions and a fragment of the plastron, together with an impression of the inner surface of practically the whole plastron. While we must regret the absence of many parts which might evidently have been preserved, there is enough of the shell present to furnish us with the essentials of the structure.

This shell has a length of 438 mm. and a width of 312 mm. The carapace (plate 42, fig. 1; text-fig. 350) forms a high vault which rises from the lower surface of the plastron about

160 mm. On the anterior portion of the carapace there is no median carina, but one of some prominence begins on the sixth neural and continues to the end of the shell. Just above the pygal plate this carina swells out into a considerable protuberance. The margin of the carapace is nowhere reverted, except slightly so behind the posterior legs. There is a slight notch in the shell just over the tail. Whether or not the edges of the rear of the carapace were to any degree serrated can not be determined with certainty, but they probably were not. Anteriorly the edge of the shell is smooth; over the neck the carapace somewhat excavated; the plastron relatively small. The lobes, especially the hinder, leave large spaces between the upper and lower parts of the shell. The bridge is narrow antero-posteriorly.

The shell is rather thin in the dorsal and costal regions, from 4 mm. to 6 mm., but thickens toward the margin, the last peripheral being about 10 mm. thick. The surface of the carapace is usually smooth.

In the middle line of the carapace we find, behind the nuchal, 8 neural plates and 2 suprapygals and the pygal. The first neural is of elongated oval form. The others, from the second to the sixth, inclusive, are elongated hexagonal, with the broad end in front. The following table gives the dimensions of the nuchal, the neurals, the two suprapygals and the pygal. There are added the dimensions of *B. wyomingensis*, reduced to millimeters, from Leidy.

Bone.	*Baptemys fluviatilis.*		*Baptemys wyomingensis.*	
	Length.	Width.	Length.	Width.
Nuchal	63	98	70	95
Neural 1	60	30	58	27
2	47	34	47	30
3	50	31	49	30
4	91	31	..	30
5		..	..	..
6	38	34	37	34
7	22	31	21	36
8	27	31	15	25
Suprapygal 1	27	38	19	30
2	46	90	28	34
Pygal	43	29	..	..

The peripherals are high, the first being 55 mm.; the fourth, 62 mm.; the tenth, at least 72 mm.

The plastron (plate 42, fig. 2; text-fig. 351) is the most interesting and instructive portion of the shell. Since all but a mere fragment of it is peeled off the matrix, we must depend on the impressions left on the rock. As to the general form and most of the sutures, there can be no doubt. Its length was 282 mm. The anterior lobe was 100 mm. long, 138 mm. wide; the posterior lobe 79 mm. long, 112 mm. wide at the base. No trace is found of the hyohypoplastral suture; 212 mm. behind the front end of the plastron is seen the very plain impression of the hypoxiphiplastral suture. It runs outward to near the border of the plastron, then outward and forward, and finally turns abruptly backward to the border. We must, however, remember that we are viewing the upper surface of the plastron, and that these angulations represent processes of the bones. The xiphiplastrals had a length of 72 mm. and a width of 100 mm. in front.

There are very distinct impressions of the suture of the entoplastron and of the epiplastra. The former was, on its upper surface, approximately circular, with a median lobe in front and a narrow prolongation behind. Its length was 75 mm., the width, 55 mm. The hypoplastra have a length of 45 mm. along the midline.

The sulci are broad, but often extremely obscure; especially those which separate the vertebral scutes from the costals. The marginal sulci are usually sufficiently distinct. The transverse sulci of the vertebrals may be made out satisfactorily. As to the width of the vertebrals, the drawing indicates the position of the lateral sulci as well as the faint indications will permit. The marginal scutes did not rise on the sides as high as the peripheral bones. There appear to have been axillary and inguinal scutes. In *B. wyomingensis* there is a complete row of inframarginals.

This species differs in various particulars from *B. wyomingensis*. Some differences appear in the hinder neurals. There are in *B. fluviatilis* two suprapygals; in *B. wyomingensis*, three. It will be observed from the measurements that the hindermost suprapygal is nearly three times as wide as that of *B. wyomingensis*. There are obvious differences in the plastra, that of the present species being more pointed behind.

Genus ANOSTEIRA Leidy.

Plastron articulating with the carapace by sutures. Plastral bones 9, the entoplastron lanciform. Hinder plastral lobe small. Nuchal bone without costiform processes. Ten pairs of peripherals; 8 pairs of costals; 7 neurals. The eighth pair of costals meeting on the midline. Epidermal scutes developt at least on the carapace. The vertebrals greatly modified.

Type: *Anosteira ornata* Leidy.

Dr. Leidy did not definitely refer this genus to any family, but regarded it, with *Baëna*, *Chisternon*, and *Baptemys*, as apparently intermediate to the Pleurodira and the Chelydridæ (Contrib. Ext. Fauna, etc., p. 341). Cope (Amer. Naturalist, XVI, 1882, p. 990; Vert. Tert. Form. West, 1884, p. 112) arranged the genus under the Chelydridæ; but in the same family in close relation with *Anosteira* he included also *Claudius*. He arranged *Dermatemys* among the *Emydidæ*. Baur (Ann. Mag. Nat. Hist., ser. III, 1889, pp. 58, 276; Proc. Acad. Nat. Sci. Phila. 1891, p. 420) favored placing it with either *Staurotypus* or *Kinosternon*, according as the entoplastron might or might not be found to be present. Mr. Lydekker (Cat. Foss. Rept., III, 1889, p. 143) places the genus in the subfamily Anosteirinæ under the Chelydridæ. Hay in 1902 (Bibliog. and Cat. Foss. Vert. N. A., p. 446) raised this group to family rank, but this had already been suggested by Baur.

The nearly complete shell described below, presenting as it does the entoplastron, enables us to refer the genus definitely to the Dermatemydidæ. The plastron resembles closely that of *Staurotypus salvinii*. The presence of the costiform processes in the living members of the family are not regarded as being of essential importance.

There can be hardly any doubt that *Pseudotrionyx* Dollo, of the Middle Eocene of Belgium, is a genus closely related to *Anosteira*.

Anosteira ornata Leidy.

Plate 43, figs. 1, 2; text-figs. 352–354.

Anosteira ornata, LEIDY, Proc. Acad. Nat. Sci. Phila. 1871, p. 102; Ann. Report U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 370; Contrib. Ext. Fauna West. Terrs., 1873, pp. 174, 341, plate xvi, figs. 1–6.—HAY, Bibliog. and Cat. Foss. Vert. N. A. 1902, p. 447; Bull. Amer. Mus. Nat. Hist., XXII, 1906, p. 157, figs. 2, 3.

Anostira ornata, COPE, Ann. Report U. S. Geol. Surv. Wyoming, etc., 1872 (1873), p. 621; Amer. Naturalist, XVI, 1882, p. 989, fig. 7; Vert. Tert. Form. West, 1884, p. 128.—DOLLO, Bull. Mus. Roy. Belgique, IV, 1886, p. 93, pl. ii, figs. 7, 8.

This beautiful and interesting species was based originally on 4 individuals, some of which had been discovered at Church Buttes and others at Grizzly Buttes, Wyoming. Where these types now are the writer does not know. It is possible that some of them are included under No. 4062, of the U. S. National Museum. The specimen figured by Leidy was obtained somewhere in the neighborhood of Fort Bridger. It is now in the collection of the Philadelphia Academy. All of his specimens appear to have come from the lower portion of level B of the Bridger Eocene. The American Museum expedition of 1903 found fragmentary specimens of the species at Grizzly Buttes and on Cottonwood Creek. The expedition of 1905 secured at Henry's Fork a nearly complete shell, which is here described and figured (plate 43; text-figs. 352, 353). This comes from a higher level than the other known specimens.

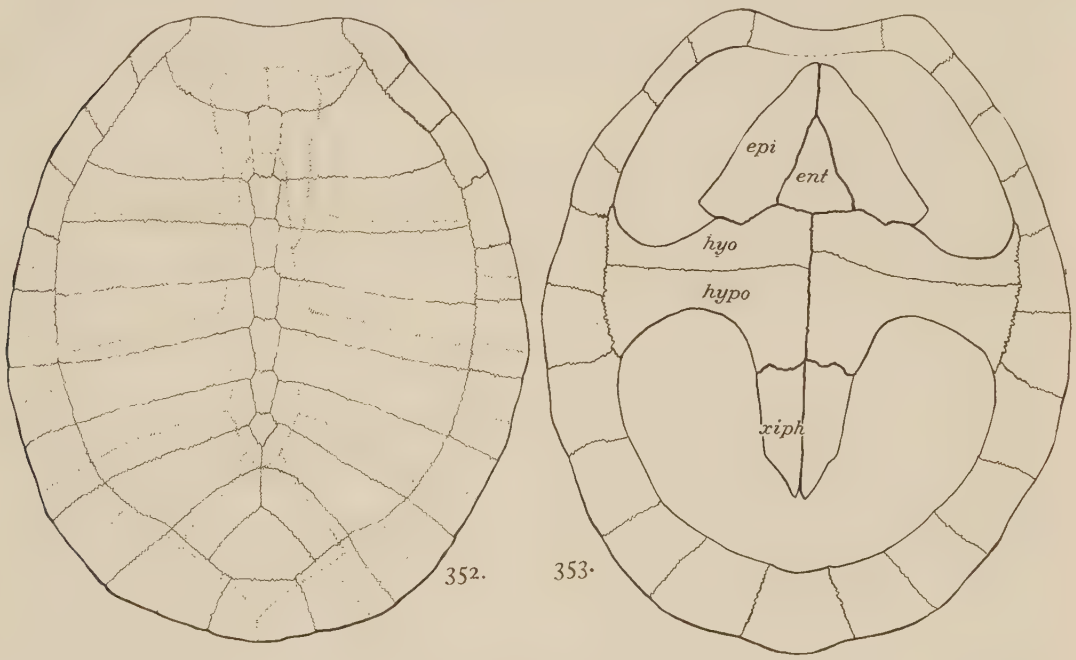
Leidy's reconstruction of this species attributed to it 11 pairs of peripherals. Dr. Baur was the first to correct this error. The complete specimen just mentioned confirms Baur's statement.

The specimen found at Henry's Fork belongs to the third division of level C. It has the number 6132, of the American Museum. The specimen is slightly crusht. The neurals (fig. 352) are all missing, as well as the left front part of the carapace. In form the carapace is not so much excavated in front as is represented in Leidy's figure. Other specimens of the species show as little excavation.

The total length of the carapace (plate 43, fig. 1; text-fig. 352) along the median line is 125 mm. The width is 105 mm. The nuchal is slightly damaged, but its length has been close to 20 mm. and the width the same. The free border is subacute; the thickness at the midline

is 5 mm. There are eight pairs of costals. Those of the seventh pair join for a short distance behind the seventh neural; those of the eighth pair join their full width. The costals are thin, about 1 mm. in thickness. There is a single large, roof-shaped suprapygal, whose length is 18 mm. and whose width is 20 mm. The pygal has a height of 15 mm. and a width of 23 mm. The anterior peripherals are about 12 mm. high, at right angles with the free border. Behind the fifth this dimension increases until in the ninth it is 20 mm. The fourth and fifth are in contact with the hyoplastron; the fifth, sixth and seventh, with the hypoplastron. Fig. 354 represents the anterior ends of the sixth, seventh and eighth. The free border of those in front of the bridge is subacute; that of those behind the bridge, thin and acute. The lower face of the anterior peripherals is smooth, while that of the posterior is sculptured. The latter peripherals have a third, or inner face. This looks toward the interior of the shell and is concave.

The carapace is exquisitely sculptured, the costals differently from the peripherals. The costals are crost, parallel with the axis of the animal, by low undulating ridges, most distinct



FIGS. 352 AND 353.—*Anosteira ornata*. Carapace and plastron. ×⅔. No. 6132 A. M. N. H.

352. Carapace.
353. Plastron. *ent*, entoplastron; *epi*, epiplastron; *hyo*, hyoplastron; *hypo*, hypoplastron; *xiph*, xiphiplastron.

on the distal ends. The nuchal and the peripherals are ornamented by sharper ridges and pustular elevations. In general, the ridges and the rows of pustules on the proximal half of each of these bones run parallel with the costal border. Those on the distal half radiate from a focus placed some distance away from the free border. On the lower faces of the six hindermost peripherals of each side the radiations extend to the proximal borders.

The epidermal sulci are narrow and delicately impressed, but most of them may be traced. On the nuchal and the four anterior peripherals the intermarginal sulci can not be seen, owing to the sculpture. On the other peripherals the ascending sulci are easily followed, but the costo-marginal sulci are not visible. From this and other specimens it becomes quite certain that they ran along the upper borders of the peripherals, just below the costo-peripheral sutures. On the pygal a median sulcus ascended about half the height of the bone, then divided and sent a right and left into the costo-marginal sulci. The vertebral scutes appear to have been remarkably modified. The first has a width of 18 mm. in front. We have a right to look for a transverse sulcus crossing this region on the proximal ends of the first costals and the first neural; but there is no trace of it. Instead of this, we find that the sulcus which

usually crosses on the proximal ends of the third costals and the third neural starts, as usual, on the third costals, but is carried forward so as to cross on the first neural. This sulcus in the specimen is very distinct; besides this, it has been observed on another specimen. In the median line, on the front of the first vertebral, is seen a distinct sulcus which runs backward to the hinder border of the nuchal bone. Whether or not it extended further can not be determined. Probably it attained to the transverse sulcus on the first neural. Apparently the only explanation of this condition is to suppose that the first and second normal vertebrals have coalesct; that the sulcus between the second and the third has been carried forward to the first neural and even to the nucho-vertebral sulcus; thus dividing the united first and second vertebrals into right and left halves.

It seems probable that the third and the fourth vertebrals have coalesct; for no sulcus crosses the proximal ends of the fifth costals and the fifth neural. The vertebral occupying the area of the fifth in other turtles has a length of 37 mm. and a width of about 30 mm. As an individual peculiarity, the fourth costal scute of the left side is divided by a sulcus which descends on the seventh costal bone.

Fortunately the present specimen furnishes the epiplastra and the entoplastron, elements not observed before (plate 43, fig. 1; text-fig. 353). The epiplastra are 37 mm. long; the width is 13.5 mm. at the middle of the length. They narrow anteriorly. The entoplastron is 19 mm. long, pointed in front, 14 mm. wide behind. These parts resemble considerably those of *Staurotypus salvinii* (Boulenger's Chelonia, p. 31, fig. 10) but the entoplastron is more pointed in the fossil species and the epiplastra are not so prolonged at their hinder outer angles.

FIG. 354.—*Anosteira ornata*. Anterior ends of three peripherals. No. 6132 A. M. N. H.

x, sixth peripheral; *y*, seventh; *z*, eighth.

The whole length of the plastron is 86 mm. The bridges have a minimum width of 15 mm. It joins the peripherals by coarse sutures. The hyoplastron is only 4 mm. wide on the bridge. Its greatest fore-and-aft breadth is 11 mm. The fore-and-aft extent of the hypoplastra is 21 mm.; that of the xiphiplastra, 27 mm.

The bones of the plastron are markt by fine ridges and intervening grooves. On the epiplastra these radiate from a point near the inner border, near the hinder end. On the bridge the sculpture is transverse to the length of the body.

Neither on this specimen nor on any others has the writer been able to find evidences of epidermal scutes on the plastron. Doubtless these were present, but they were so delicate that their boundaries have left no impressions on the bones. Dr. Baur could not find the sulci on the plastron of specimens at Yale.

Cope has mentioned the finding of specimens of this species on the "Upper Green River." No. 1059 of the American Museum of Natural History bears his label to the effect that it was found on Green River, at the mouth of the Sandy. The strata here belong to the lowest level, A, of the Bridger. These have furnisht also *Amyda æqua*. Cope's specimen is somewhat differently sculptured from the specimens from a higher level, the pustules predominating over the ridges, on the peripherals. It is, however, probably not a distinct species.

The evidence at hand shows that this species ranges from the lowest level of the Bridger beds to the top of that known as C.

Anosteira radulina Cope.

Anostira radulina, COPE, Palæont. Bull. No. 9, 1872, p. 555; Proc. Amer. Philos. Soc., XII, 1872, p. 555; Ann. Report U. S. Geol. Surv. Montana, etc., 1872 (1873), p. 620; Vert. Tert. Form. West, 1884, p. 128, plate xviii, figs. 18, 19.
Anosteira radulata, BAUR, Ann. Mag. Nat. Hist. (6), III, 1889, p. 273.
Anostira radiolata, LYDEKKER, Cat. Foss. Rept., III, 1889, p. 144.
Anosteira radulina, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 447.

This species was described by Cope from two peripheral bones, one from in front of the bridge, the other from behind it. These are now in the U. S. National Museum and have the number 4096. They were found in the Bridger Eocene near Ham's Fork, Wyoming, therefore in the lowest division, A, of the formation. The individual that furnisht these bones was

estimated by Cope to have been about twice the size of the specimens of *A. ornata* that had then been found. He concluded that it belonged to a distinct species for the reason that the sculpture had not increast in coarseness corresponding to the increase in size of the animal. This, however, is not a sufficient reason. Since the bones increase in size by additions to their borders, the lines and pits of the sculpture once formed will not change in coarseness. A better reason for regarding the bones as those of a species different from *A. ornata* is to be found in their form. The anterior peripheral, the first of the left side (Cope's fig. 18), has the form of a rhomboid, quite different from that of any anterior peripheral of *A. ornata*. The lower side of Cope's figure is that of the free border of the bone. The thickness of the bone is 7 mm. The hinder peripheral appears to be the ninth or tenth. It is 7 mm. thick and its free edge is obtuse. In *A. ornata*, on the contrary, it is acute.

The length of the anterior peripheral, along the free edge, is 25 mm.; its height is 28 mm. Both these dimensions in the hinder peripheral are 25 mm. The sculpture of the anterior bone is stated to consist of closely packt vermicular ridges which run out flat on the posterior and upper borders. In the posterior the ornamentation consists of closely placed minute tubercles over the whole surface, these being more or less confluent on the posterior and upper borders.

Mr. R. Lydekker has described and figured a species called *Anosteira anglica*, from the Lower Oligocene of Hordwell, England (Cat. Foss. Rept., III, p. 143, figs. 34, 35). Dr. G. Baur (Ann. Mag. Nat. Hist., III, 1889, p. 273) has stated that this can not be distinguisht from Cope's *A. radulina*. A glance at the figures of the two forms shows that they can not be identical, the sculpture of the English species being far coarser. In *A. ornata* the suture between the hypoplastron and the xiphiplastron, in crossing from the free border to the midline, runs first forward, then backward, then forward again. In the English species it runs obliquely, but directly, inward and forward. It is not probable that two species of the same genus would be so different.

Genus XENOCHELYS Hay.

Characters drawn from the type and only known specimen. Neurals 6, the 4 anterior having the narrow end directed forward. Only 7 pairs of costals; those of the sixth and seventh pairs meeting at the midline. Ten pairs of peripheral bones, and 11 pairs of marginal scutes; the nuchal scute very small. Plastron joined to the carapace without buttresses. Bridge narrow. Only 5 pairs of plastral scutes. Two inframarginals on each bridge.

Type: *Xenochelys formosa* Hay.

This genus differs from *Dermatemys* in having no axillary or inguinal buttresses; 5, instead of 6, pairs of plastral scutes; and in the form of the anterior neurals. In the reduced number of peripheral bones and marginal and plastral scutes it resembles *Staurotypus*. In the latter genus, too, 3 of the anterior neurals have the narrower end directed forward. The width of the bridge of *Xenochelys* is intermediate between that of *Dermatemys* and that of *Staurotypus*. The two genera just mentioned, as well as *Claudius*, the nearest living relatives of *Xenochelys*, are inhabitants of Central America.

Xenochelys formosa Hay.

Text-figs. 355, 356.

Xenochelys formosa, HAY, Bull. Amer. Mus. Nat. Hist., XXII, 1906, p. 29, figs. 2, 3.

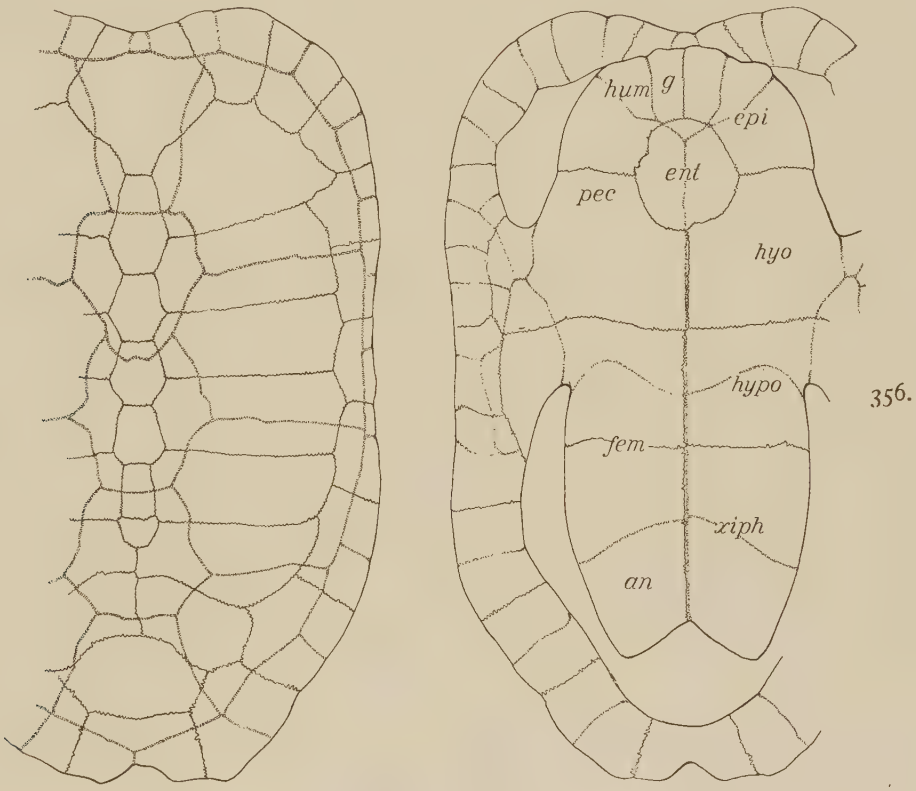
Of this species there is at present known only the specimen which serves as the type. This was discovered in the year 1904, at Quinn Draw, Washington County, South Dakota, by Mr. Albert Thomson, of the American Museum of Natural History. The deposits in which it was found belong to the lower division of the Titanotherium beds of the White River Oligocene. The specimen consists almost wholly of the shell, and this is somewhat crusht. The plastron is driven upward into the carapace, and a small portion of the left margin of the carapace is wanting. The whole structure of the shell can nevertheless be determined.

The length of the carapace (fig. 355), measured in a straight line, is 200 mm.; the greatest width 129 mm. The shell is therefore slightly narrower proportionally than that of *Dermatemys mawii*. The height was moderate. A low rounded carina is found on the nuchal

and another on the hinder end of the carapace. There are slight traces of a lateral carina on each side, along the outer borders of the vertebral scutes. In outline the carapace is slightly excavated in front and notcht behind. The borders behind the inguinal notches were very slightly flared upwards. The nuchal bone is well developt, having a length and breadth each of 38 mm. There are no costiform processes. Of the 6 neurals the anterior 4 are hexagonal, with the narrower end directed forward, a somewhat unusual thing among both Cryptodire and Pleurodire turtles; nevertheless occurring, according to Dr. Boulenger's figures, in the case of some of the neurals of *Staurotypus*, *Kinosternon*, *Cyclemys*, *Geomyda*, and *Cyclemys*. The sixth neural of our species is quadrate, the seventh is triangular. The table gives the dimensions of the neurals.

Neural.	Length.	Width.
1	25	15
2	18	16
3	18	16
4	16	13
5	15	10
6	8	11

Behind the costals of the seventh pair there is a single suprapygal, 22 mm. long and 38 mm. wide. This is succeeded by the notcht pygal, which has a length of 23 mm. and a width of 28 mm.



FIGS. 355 AND 356.—*Xenochelys formosa*. Carapace and plastron of type. ×½.

355. Carapace.
356. Plastron. *an*, anal scute; *ent*, entoplastron; *epi*, epiplastron; *fem*, femoral scute; *g*, supposed gular scute; *hum*, supposed humeral scute.

As already stated, there are only 7 pairs of costal plates, of which the two hindermost pairs reach the midline of the shell. The anterior pair is well developt, having an antero-posterior width of 35 mm. The costals are about 3 mm. in thickness.

The peripheral bones are relatively large, and there are only 10 of them on each side. The second measures 26 mm. from the free border to the union with the costal plate; the third, 35 mm. The free borders of the anterior and posterior peripherals are acute. They attain a maximum thickness of about 9 mm. The sulci bounding the epidermal scutes are moderately imprest. There is a very small nuchal scute. The vertebral scutes have a width each of about

35 mm. The first has a length of 45 mm. In form the vertebrals resemble those of *Staurotypus salvinii*. Along the hinder ends of each of the lateral borders of the three anterior vertebrals there is a very deeply imprest groove. In the case of the first and second vertebrals these grooves extend backward on that neural bone which is crost by the hinder border of each vertebral respectively. The grooves along the third vertebral scute run backwards on the proximal ends of the costals of the fifth pair.

The marginal scutes rise relatively little above the free borders of the shell, the second having a fore-and-aft extent of only 13 mm.; the tenth, of only 15 mm. The costal scutes are therefore relatively broad.

The plastron (fig. 356) has a total length of 163 mm. Where narrowest, the bridge has a width of only 43 mm. The axillary and inguinal notches are very narrow. The plastron was united with the carapace by a close suture, but there are no buttresses rising from the plastron. The anterior lobe has a length of 52 mm. and a width of 80 mm. at the base. It is broadly rounded in front and somewhat repand. The border is acute. The entoplastron is broadly oval, 29 mm. long and 27 mm. wide. The hinder lobe has a length of 75 mm., and a basal width of 62 mm., and is deeply notcht behind. The free border is acute, but the thickness increases above, so that where the soft skin began the thickness was 6 mm. In the middle of the upper surface of each xiphiplastron there is a rather deep, smooth impression, which was probably for the lateral process of the pubis.

According to Rütimeyer (Denkschr. schweiz. naturf. Gesellsch., xxv, 1873, p. 152) *Dermatemys mawii* possesses on each xiphiplastron a depression (Bandgrube) for the insertion of the lateral process of the pubis.

The antero-posterior extent of the epiplastra is 35 mm.; that of the hyoplastra, 41 mm.; that of the hypoplastra, 30 mm.; that of the xiphiplastra, 57 mm.

Besides the inframarginal scutes, there are only 5 pairs on the plastron of this species. Of the inframarginals there are 2 on each bridge—a small anterior and a large posterior.

It is difficult to interpret the anterior plastral scutes. Posteriorly we find anals and femorals, in the usual positions. In front of the sulcus bounding the latter anteriorly there is not a trace of a transverse sulcus until we reach the anterior end of the entoplastron. Occupying the front of the anterior lobe are 2 pairs of scutes, which look like intergulars and gulars; altho it is not certain that the former are not consolidated into a single scute. It is evident that there has occurred either a fusion of 2 pairs of scutes or an extirpation of one pair. If the most anterior pair are intergulars, we must account for the absence of 2 pairs of scutes. In *Dermatemys* the humero-pectoral sulcus has moved forward to near the anterior end of the hyoplastron. In *Adocus pectoralis* this sulcus has lain partly on the epiplastron. It appears probable, therefore, that in *Xenochelys* the sulcus named has moved far forward; that is, to the middle of the epiplastron. If this is the case, we have here gulars and humerals, instead of intergulars and gulars. We have then to suppose either that the pectorals and the abdominals have fused, without a trace of the sulcus between them, or that the pectorals have extended backward so as to suppress the abdominals. In *Testudo osborniana* the pectorals have been nearly suppresst by the forward expansion of the abdominals. The writer accepts the view that in *Xenochelys* we have present the gulars, humerals, pectorals, femorals, and anals. The pectorals have an antero-posterior extent of 68 mm. at the midline; the femorals a similar extent of 32 mm.; the xiphiplastrals, of 37 mm.

It may be noted here that the specimen of *Dermatemys mawii* figured by Dr. Boulenger (Catalogue of Chelonians, p. 28) possesses only 7 pairs of costal plates. Amié Bienz (Rev. suisse Zool. et Ann. Mus. d'Hist. Nat. Genève, III, p. 61) states that the species has 8 pairs of costals. The same statement is made by Dr. Rütimeyer (loc. cit.).

Family EMYDIDÆ Gray.

Cryptodire turtles distinguisht by the following characters: Shell covered with epidermal scutes. Peripherals articulated to costals by close sutures and by gomphosis of rib-ends. Neurals in full series. Bridges broad, usually sutured to peripherals; in rare cases ligamentously attacht. Plastron broad, composed of 9 bones, the mesoplastron never present. No intergulars and no inframarginals, except axillary and inguinal. Procoracoid process forming

a right angle with the scapula. Coracoids not expanded at the distal ends. Humerus with the radial and ulnar processes diverging. Digits usually elongated and the median ones furnisht with three phalanges; only in *Terrapene* are the median anterior digits reduced to 2 phalanges. Feet fitted primarily for walking, but nearly always provided with a web between the toes.

Skull without temporal roof, except the zygomatic and postorbital arches, the former occasionally wanting. Stapedial passage open. Neck completely retractile within the shell.

In the present work the writer, following by conviction the example of a large number of students of herpetology, the names of whom are mentioned by Louis Agassiz in his Contributions to the Natural History of the United States (vol. 1, p. 356), has separated the true land-tortoises, the Testudinidæ, from the more or less aquatic forms that are to be known as the Emydidæ. For this course there appears to be found in the structures of the two groups abundant justification. Furthermore, the two families have been clearly separated ever since the time of the Lower Eocene.

Even as thus restricted the Emydidæ contain more genera and species than any other family of Testudines. According to Mr. G. A. Boulenger's Catalogue of Chelonians, the Emydidæ, excluding the land-tortoises, embrace seventeen genera and sixty-four species; and these numbers are to be increast, rather than diminisht. Probably no other family displays a greater range of habits. Some of the species are almost wholly aquatic, as those of the genera *Chrysemys* and *Graptemys;* others are semiaquatic, as the members of *Emys* and *Clemmys;* while still others, as *Terrapene*, are nearly as terrestrial as the Testudinidæ themselves. Of the aquatic forms a few, as the diamond-back terrapins (*Malaclemys*) affect the salt waters of the sea-coasts; while the greater number inhabit fresh-water lakes and streams. Most of the species are carnivorous in their diet, but a few, as the box-tortoises (*Terrapene*) subsist on vegetation.

As regards their present-day distribution, the Emydidæ are found occupying portions of all the continents and the larger islands of the warmer portions of the globe, except Australia and the neighboring islands (fig. 13, page 33). It is evident that by some ancient connection of Australia with other lands, probably with Asia, the Pleurodires were enabled to occupy that southern continent, as well as New Guinea; but this connection was interrupted before the Emydidæ and the Testudinidæ had passed over that bridge.

Altho the Emydidæ have secured a foothold in the African continent, their distribution is limited to the northwestern and northern coasts. Only 2 species are known from Africa—*Emys orbicularis* and *Clemmys leprosa*. The first is widely spread over Europe and southwestern Asia and is found in Algeria. It is within the range of possibility that it has been introduced into Algeria through human agency. *Clemmys leprosa* is found along the southern Mediterranean coast, from Tunis to the Atlantic, thence southward to Senegal. It has evidently entered Africa at a late geological period and has prest southward along the Atlantic coast until it has reacht the border of the Ethiopian region. To turtles, as to other groups of animals, the Sahara desert has for a long period stood as a barrier to their southern migration.

It is a fact difficult, perhaps impossible, of explanation at present, that while the Emydidæ are absent from the Ethiopian region, the Testudinidæ, a strictly terrestrial family, and the Trionychidæ, wholly aquatic in their habits, abound in that great region. It might seem that where the Trionychidæ could go the Emydidæ could easily follow. However, the Trionychidæ are a much older family and might have entered Africa before the Emydidæ had become widely distributed and at a time when the connections of the continents were greatly different from those now existing. It seems establisht that some of the species of Trionychidæ have been able to adapt themselves to life in sea-water, and this ability may have allowed them to work their way along sea-coasts from one fresh-water region to another.

The Testudinidæ, on the other hand, are less dependent on abundance of water for existence than are the Emydidæ and might have made their way across the Sahara or the deserts of western Asia into the Ethiopian region. To the writer it appears more probable that the land-tortoises reacht Africa from India by a land connection, of which the Seychelles, Mauritius, the Aldabras, and Madagascar are remnants which within recent or Pleistocene times have been inhabited by gigantic Testudinidæ.

In the Pliocene deposits of the Siwalik Hills, India, there have been found five genera of Emydidæ. Why these did not effect an entrance into Africa in company with the various ruminants, hog-like ungulates, antelopes, monkeys and apes, is not now to be explained.

We have no certain evidence of the existence of Emydidæ before the beginning of the Tertiary. Indeed, not until the Wasatch epoch in America and the epoch of the London Clay in Europe, do we find undoubted Emydidæ. When they do appear they are in many respects as advanct as are some of the living forms. We can not, therefore, doubt that they had a much earlier beginning and we may await with confidence the discovery of their predecessors in Cretaceous deposits. The genus *Gyremys*, found in the Judith River beds, is provisionally assigned to the family.

As regards the evolution of the family not much can be said. In the Eocene forms the shell resembles greatly that of the modern genera. It is composed of the same pieces and these are arranged in the same way. Most of the forms from the Wasatch and the Bridger possess strongly developt axillary and inguinal buttresses, such as we find to-day in a number of Asiatic genera. There appear to have been other genera which did not possess such buttresses, and from such as these have probably descended most modern forms.

We are, unfortunately, without sufficient materials to enable us to determine the structure of the rest of the skeleton. The limbs of the Bridger turtles, so far as represented, were not different from those of living aquatic emyds. Only a single Bridger emyd skull is known, and this was not associated with a shell. This skull resembles considerably that of our genus *Clemmys*, the triturating surfaces of the jaws being narrow and with only a rudimentary longitudinal ridge. In many modern genera of this family the jaws have become broadened and the maxillary, and sometimes the mandibular, triturating surfaces have developt one or more longitudinal ridges. The horny plates which cover these surfaces are often rough with processes that resemble and function as teeth. The living genus *Terrapene*, as befits its terrestrial mode of life, has simulated many of the features of *Testudo*. The shell has become inflated, the digits shortened, and the diet a vegetable one. Besides these modifications, the plastron has become movable on the carapace and a hinge has developt between the hyoplastron and the hypoplastron. Even in the Lower Oligocene the genus *Ptychogaster* had developt somewhat similar structures.

Mr. G. A. Boulenger (Catalogue of Chelonians, p. 49) has exprest the opinion that the genus *Emys* is, in many respects, the least specialized of this family and might be placed at the base of the family, with two series of genera culminating, on the one hand, in the Batagurs and, on the other, in the land-tortoises. The present writer can not agree in this opinion. He holds first of all that the land-tortoises form a distinct family which diverged from the Emydidæ even as early as the Cretaceous. Again, *Emys* displays a rather high grade of differentiation in the ridged triturating surfaces of the jaws, and especially in the secondary loosening of the articulation between the carapace and the plastron, and in the formation of a hinge between the hyoplastron and the hypoplastron. Such a form as *Clemmys* appears to represent better the simple emyd structure. In this the jaws are narrow and smooth, the plastron is immovably articulated with the carapace, there is no hinge in the plastron, and the plastral buttresses are feeble. From such a form there might be produced the Batagurs, with their broad corrugated jaws and their powerful buttresses, and *Emys* and *Terrapene*, with their narrow jaws, their feeble buttresses, and their hinged plastra.

From what forms the Emydidæ sprang we know not as yet. We shall probably find that the limbs of the earliest Cryptodira were not greatly different from those of our aquatic Emydidæ. The shells of the family ancestral to the Emydidæ need not have differed greatly from that of *Chrysemys*, for example; for even the early Amphichelydia have the carapace and the plastron closely articulated. The buttresses of the ancestors of the early emyds were probably little developt. The neck was probably short and the head not wholly retractile within the shell. The skull was probably considerably like that of *Chelydra*, but with a more completely developt temporal roof. Perhaps the skull of *Platysternum* resembles it more. Such a family would not be greatly removed from the Thalassemydidæ.

In a paper publisht in the Bulletin of the American Museum of Natural History, vol. XXI, p. 167, the author indicated his belief that the Emydidæ had sprung from the Chelydridæ. He is now inclined to the opinion that they had their origin from some of the more primitive

Dermatemydidæ. The latter family was abundantly represented during the Upper Cretaceous and only slight modifications would be required to transform them into Emydidæ.

In Europe the earliest Emydidæ appear to be those found in the London Clay, which is of about the same age as the American Wasatch beds. Two species are found there; and these have been referred by Mr. Lydekker to *Chrysemys*, a living North American genus. Doubtless when the skulls shall have been found these species will have to be relegated to some other genus. In the Oligocene of Hordwell, England, two species occur which Lydekker refers to *Ocadia*, a genus existing to-day in China. It resembles closely the genus *Echmatemys*, but the latter probably did not have a longitudinal ridge on the maxillary triturating surface, and the plastron is less contracted than it is in *Ocadia*. No other species of Emydidæ have been discovered in England, so far as known to the writer.

On the continent of Europe, as recorded by Maack (Palæontographica, XVIII, 1869, p. 193) and by Zittel (Handbuch der Palæontologie, III, p. 537), many species of Emydidæ have been described and the greater part of them referred to *Emys*, *Cistudo*, and *Ptychogaster*. Only those called *Cistudo* are really members of *Emys* as now understood. This genus thus appears to extend back to the Oligocene. Those placed by Maack and Zittel in the genus *Emys* are probably more closely related to *Clemmys* or *Ocadia*. *Ptychogaster* is an Oligocene and Lower Miocene genus, the carapace of which resembles in many respects that of *Testudo*, while the plastron is hinged like that of *Terrapene*.

The following table shows the distribution of the North American fossil species of the Emydidæ:

Pleistocene.	Equus.	Terrapene carolina, T. eurypygia, T. marnochi, Trachemys bisornata, T. petrolei, T. trulla, Chrysemys timida, Clemmys insculpta, Clemmys? percrassa, C. insculpta, ?Pseudemys cælata.
Pliocene.	Blanco, Rattlesnake, and Peace Creek.	Terrapene putnami, ? Trachemys euglypha, T. sculpta, T. jarmani, ?Clemmys hesperia, Deirochelys floridana, Pseudemys extincta.
Miocene.	Loup Fork.	Trachemys hilli, Clemmys saxea.
Oligocene.	John Day	
	White River	Graptemys inornata.
Eocene.	Uinta.	Echmatemys callopyge, E. uintensis.
	Bridger.	Echmatemys septaria, E. shaughnessiana, E. ocyrrhoe, E. stevensoniana, E. haydeni, E. arethusa, E. naomi, E. cyane, E. ægle, E. wyomingensis, E.? latilabiata, E. pusilla, Palæotheca polycypha, P. terrestris, Clemmys morrisiæ, Hybemys arenaria.
	Wind River.	
	Wasatch.	Echmatemys lativertebralis, E. cibollensis, E. testudinea, E. megaulax, E. euthneta.
Upper Cretaceous.	Puerco.	
	Laramie.	
	Fox Hills.	
	Judith River.	?Gyremys spectabilis.

KEY TO GENERA OF EMYDIDÆ.

A. Insufficiently known genera.
  a^1. Carapace broad as long; the outer surface sculptured somewhat as in Trionychidæ. . *Gyremys*
  a^2. Small Bridger species, with dorsal keel and thick bones ..... *Palæotheca*
  a^3. A hemispherical boss situated on each interperipheral suture ..... *Hybemys*

AA. Better known genera.
  a^1. Axillary and inguinal buttresses strongly developt; the latter projecting well into the cavity of the shell and rising high above the costo-peripheral suture ..... *Echmatemys*
  a^2. Buttresses rising but little above the costo-peripheral sutures.
    b^1. Plastron without either lateral or transverse hinge.
      c. Crushing-surface of upper jaw with feeble or no longitudinal ridge.
        d^1. Humero-pectoral sulcus crossing the entoplastron ..... *Clemmys*
        d^2. Humero-pectoral sulcus crossing behind the entoplastron.

1. Shell smooth; no dorsal keel; crushing-surface of upper jaw with a feeble ridge; rib-heads well developt ..... *Chrysemys*
2. Surface of shell sculptured; rib-heads thread-like ..... *Deirochelys*
3. Shell smooth or wrinkled; crushing-surface of upper and lower jaws broad and flat; palatine bones joining vomer in front of choanæ ..... *Graptemy*

c^2. Crushing-surface of upper jaw with a strong longitudinal ridge.

4. At least a trace of a dorsal keel; carapace often sculptured; crushing-surface of upper jaw with a denticulated ridge highest in front ..... *Trachemys*
5. Crushing-surface of upper jaw very broad, with a denticulated longitudinal ridge; lower surface of lower jaw flat ..... *Pseudemys*

b^2. Plastron completely filling the opening of the carapace; furnisht with both lateral and transverse hinges ..... *Terrapene*

Genus GYREMYS nov.

Shell deprest; as broad as long, or broader; with plastron and carapace sculptured as in the Trionychidæ; both furnisht with epidermal scutes, the vertebrals very broad. Carapace with a complete set of peripherals. Neurals mostly hexagonal, with the broader end forward. Plastron without fontanels, and joined to the carapace by means of anterior and posterior buttresses. Apparently no mesoplastra present.

Type: *Gyremys spectabilis*.

This genus differs from *Glyptops*, as represented by *G. plicatulus*, in the form of the carapace, the width being greater than the length, and in the character of the ornamentation of the shell. The lack of mesoplastra, if confirmed, will be decisive in showing its non-relationship to *Glyptops*. In the latter genus, as well as in *Pleurosternon*, the suture between the hypoplastra and the xiphiplastra runs across the plastron in a straight line or is even deflected backward at the midline, apparently a primitive character; while in *Gyremys* the suture is deflected forward at the midline.

Provisionally this genus is arranged with the Emydidæ. No intergulars or inframarginals have been observed, but they may nevertheless have been present. It is possible that the genus belongs among the Dermatemydidæ.

Gyremys spectabilis sp. nov.

Plate 44, figs. 1, 2; text-figs. 357, 358.

Under this name there is here described a remarkable turtle which was collected in 1876 for Professor Cope, by Messrs. Sternberg and Isaac, in the Judith River deposits of Montana. Apparently the remains were never examined by Professor Cope, and the many fragments of which it was composed were put together after it came to the American Museum of Natural History. The specimen bears the number 1171.

The bones of this turtle were originally thin; and as a result of the conditions attending fossilization they have been much fractured. Consequently, it is difficult to determine the positions of some of the sutures and scutes, especially those of the carapace.

As regards the parts remaining, the plastron is complete; the carapace lacks the nuchal bone, the right first peripheral, the left first costal, and several of the left peripherals.

The shell was a remarkably broad and flat one. The total length of the carapace (plate 44, fig. 1; text-fig. 357) was about 440 mm.; the width, 500 mm. Hence, the shell was broader than long. As restored, the height of the carapace above the bottom of the plastron is only 70 mm. It was no doubt more elevated during life, but probably not much.

The ornamentation of the shell consists, where distinctly displayed, of low, short, irregular ridges, separated by grooves of the same width, and occasionally anastomosing. There are about five ridges in 10 mm. The central portions of the carapace, however, are nearly smooth. In most parts of the shell the sculpture is so effaced that its character can hardly be determined, beyond the fact that it resembles that of the Trionychidæ.

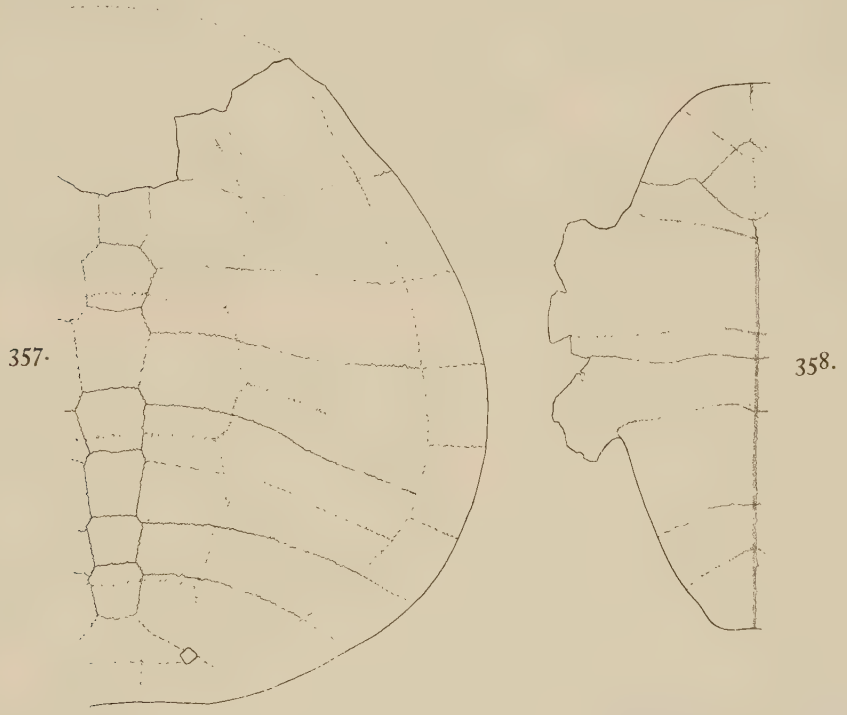
However, the relationships of this turtle are not with the Trionychidæ, but with the Cryptodira; for the plastron is completely closed and the costals are surrounded by a complete

set of peripherals. No fontanels occur anywhere, except apparently a small one on each side of the suprapygal.

On account of missing parts, the outline of the front of the carapace can not be determined. The shell was broadest across the inguinal region. The hinder border shows a broad shallow excavation. An attempt has been made to map out the areas occupied by the neurals, costals, and peripherals. The position of most of these has been determined pretty satisfactorily. The extent of the peripherals is somewhat conjectural, as shown by the interrupted lines in the drawing. Most of the sutures had to be traced on the inside of the carapace. As there seen, the costals approach to within 45 mm. of the free border of the carapace.

So far as can be determined, the inguinal buttresses rest against the fifth and sixth costals. The buttresses did not rise to a great height. The ribs were quite prominent on the under side of the costal plates. The rib-heads were strongly developt. The tenth rib formed an abutment for the upper end of the ilium.

The first neural is missing. The second has the front border wanting, but it was about 48 mm. long and 27 mm. wide. The third is hexagonal, 46 mm. long and 48 mm. wide. The



FIGS. 357 AND 358.—*Gyremys spectabilis*. Carapace and plastron of type. $\times\frac{1}{6}$.

357. Portion of carapace. 358. Plastron.

limits of the fourth are uncertain; it may have been wider than represented. The plotting of the areas behind the eighth neurals and costals is to some extent conjectural. The thickness of the costals is from 7 mm. to 10 mm.; but the ribs added something to this in the middle of the breadth.

The scutal areas are even more difficult to determine than are the bones. Enough, however, is determinable to prove that the vertebral scutes were very broad, the second and the third having had a breadth of about 170 mm. The boundaries of the fourth are conjectural, but probably not greatly different from the drawing. Toward the borders of the carapace no sulci are to be detected and no attempt has been made to represent them.

The plastron (plate 44, fig. 2; text-fig. 358) is well preserved, altho the external layer of bone on its upper surface is eroded away. The lower surface is in better condition, but the bone is much fractured. The total length of the plastron is 425 mm. The anterior lobe is broad and rounded in front; the hinder is somewhat wedge-shaped, with the extremity trun-

cated. The anterior lobe is 240 mm. wide at the base and 118 mm. long. There is no specialized epiplastral lip. The bones are about 10 mm. thick, and the free borders are subacute. The posterior lobe is 144 mm. long and 205 mm. wide at the base. The lateral borders are somewhat convex in outline, and they converge toward the rear. The latter is truncated and about 50 mm. wide. The median and the hinder portions of the lobe are thin, from 4 mm. to 8 mm. From the acute borders of the hypoplastron the bone thickens inward a distance of 30 mm., then grows thinner.

The axillary and the inguinal buttresses extend inward little further than the free borders of their respective lobes. The entoplastron is diamond-shaped, with the posterior angle rounded. It is 75 mm. wide and 65 mm. long. The hyoplastra occupy 112 mm. of the midline; the hypoplastra about 110 mm.; the xiphiplastra, 100 mm. A very careful examination fails to discover the presence of mesoplastra.

The gular scutes appear extraordinarily large and the shallow grooves which are taken to represent them may be deceptive. No evidences are found of the presence of intergulars, but they may have existed. The gulars overlap the front of the entoplastron. The humero-pectoral sulcus does not cross any part of the entoplastron. The humerals extend along the midline 38 mm.; the pectorals, 75 mm.; the abdominals, 62 mm.; the femorals, 110 mm.; the anals, 40 mm. It is impossible to make any statement regarding the scutes of the bridges.

Genus CLEMMYS Ritgen.

Shell only moderately elevated. Neural plates hexagonal, with the broader ends forward. Usually, but not always, at least some traces of a dorsal keel. Axillary and inguinal buttresses feeble, extending upward little, if any, above the lower borders of the costals; the inguinal articulating with the fifth costal. Humero-pectoral sulcus crossing the entoplastron. Plastron notcht behind. Triturating surfaces of the jaws narrow, not furnisht with ridges. Choanæ between the eyes.

Type: *Clemmys punctata* Schoepff=*C. guttata* Schneider.

At the present day there are about 6 living species of this genus. These inhabit Europe, northwest Africa, southwestern Asia, China, Japan, and North America. Four of the known species occupy portions of North America, 3 of them being limited to the region east of the Mississippi River, 1 to the Pacific coast. In the present work five fossil species, all based unfortunately on fragmentary materials, are referred to this genus. One of these, *C. saxea*, belongs to beds believed to be Pliocene, a second species, *C. hesperia*, to the Mascall beds of the Upper Miocene; a third species, *C. morrisiæ*, to the Bridger Eocene; a fourth supposed species is *C. percrassa* Cope from the Pleistocene cave near Port Kennedy, Pennsylvania. It seems probable that North America is the original home of the genus and that the Old World has received its stock from the New World.

The descriptions of the species of this genus are introduced at this stage because it appears to the writer that the structure is rather primitive and that from this genus may have been developt almost any of the other forms of the Emydidæ.

1. Eocene species (Bridger beds):
   Resembling *C. muhlenbergi* ..... *morrisiæ*
2. Upper Miocene species (Mascall beds):
   Resembling *C. marmorata* ..... *hesperia*
3. Pliocene species (Rattlesnake beds):
   Pygal bone transversely convex ..... *saxea*
4. Pleistocene species:
   Hinder lobe greatly thickened ..... *percrassa*
   Hinder lobe moderately thickened ..... *insculpta*

Clemmys morrisiæ sp. nov.

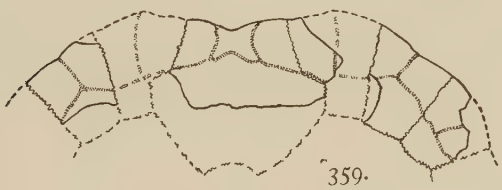
Plate 45, figs. 1–3; text-figs. 359, 360.

Of this interesting species there were collected by the American Museum expedition of 1903, in the western portion of Grizzly Buttes, portions of 4 individuals. These now have the

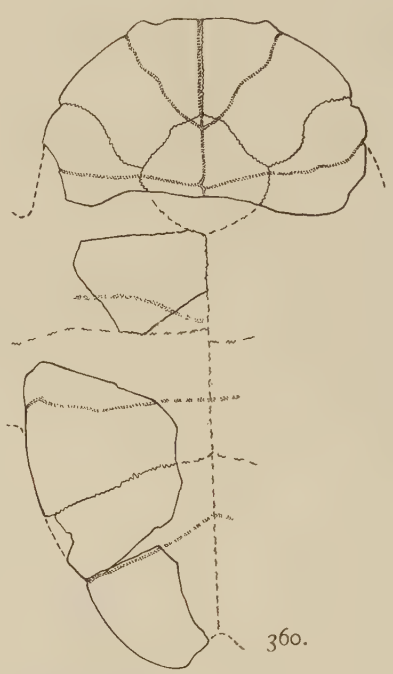
catalog numbers 6019, 6020, 6024, and 6029. The level from which these were obtained is that known as horizon B. No. 6029 is taken as the type of the species.

The portions of the skeleton presented by the specimens bear such close resemblance to the corresponding parts of *Clemmys muhlenbergi* that the species is referred provisionally to that genus.

The type furnishes most of the anterior lobe of the plastron, a portion of the hinder lobe, a part of the nuchal, parts of the right first, second, and third peripherals, and the whole free border of the left second peripheral. The nuchal (fig. 359) was about 19 mm. wide along the free border and about 32 mm. wide at the maximum. The front border is acute-edged, but the bone grows rapidly thicker until, at a distance of about 12 mm. behind the free border and near its articulation with the peripheral, it is 9 mm. thick. On the under side of the bone, at a distance of 15 mm. from the free border, behind the portion covered with horn, the thickness becomes suddenly reduced to 5 mm. The free edge of the first peripheral is acute next the nuchal. The second peripheral has a length of 16.5 mm. along the free border. This is very obtuse, especially where it joins the third peripheral. The greatest thickness of this peripheral is 9 mm. On the under side, at a distance of 12 mm. from the free edge, the thickness is abruptly reduced to 3 mm. The nuchal scute is 9 mm. wide posteriorly and about 6 mm. long. The first marginal scute had a fore-and-aft extent, or height, of 12 mm. at the distal end. The second marginal at its distal end on the second peripheral was narrowed down to 7 mm. in height. The height of the third was about 10 mm. at the distal end. On the lower side of the nuchal and of the peripherals the horny scutes extended backward as far as the thickened part of the bones continued.



359.



360.

FIGS. 359 AND 360.—*Clemmys morrisiæ*. Portions of carapace and plastron of type. $\times\frac{2}{3}$. Known portions inclosed within solid lines.

359. Restoration of front of carapace.
360. Restoration of plastron.

The anterior lobe of the plastron (plate 45, fig. 1; text-fig. 360) had a width of about 65 mm. Seen from below (fig. 360), the lobe is convex in every direction. The lip projects extremely little. Its width, measured between the gulo-humeral sulci, is 29 mm. The entoplastron has a width of 25 mm. Its length can not be exactly determined, but it probably little exceeded 25 mm. In form, so far as preserved, it resembles that of *C. muhlenbergi*. The gular scutes overlap only slightly the front of the entoplastron. Their length on the midline is 19 mm. The humerals measure on the midline 14 mm. The pectorals overlapt the hinder end of the entoplastron. The whole free border of the anterior lobe is acute, including the lip.

Plate 45, fig. 1, represents the anterior lobe as seen from above. From the free border of the lip the epiplastrals are thickened backward a distance of 20 mm., attaining a thickness of 13 mm. This is then suddenly reduced to 7 mm., forming an overhanging and somewhat excavated ledge. The sides of this thickened surface are swollen and ornamented with ridges and grooves, the marks of the growth of the gular scutes. Similar markings are seen on the epiplastrals of *C. muhlenbergi*. The portions of the gular scutes on this superior surface are as wide behind as at the free border. The thickness of the epiplastrals, where they articulate with the hyoplastrals, is reduced to 7 mm.

Plate 45, fig. 2, represents the inguinal region of the hypoplastron and the adjacent part of the xiphiplastron, seen from above. The free border is acute. The beveled, horn-covered surface, on the upper side, is 18 mm. wide and attains a thickness of 9 mm. At its inner border the thickness falls off suddenly to 6 mm. The lines of growth of the femoral scutes are displayed on this surface. Evidently there have been no strongly developt inguinal buttresses extending inward on the plastron such as we find in *Echmatemys*.

Fig. 3 of plate 45 presents a view of the upper side of the left xiphiplastron.

Fig. 360 shows the same bones viewed from below. Near the anterior border of the fragment of the hypoplastron is seen the abdomino-femoral sulcus. The femoro-anal sulcus crost the free border at the hinder end of the fragment.

No. 6024 furnishes the front of the nuchal as far backward as the bone was thickened, and the hinder portion of the left xiphiplastron. On the lower surface of the nuchal, at the midline, the thickened portion extends backward only about 12 mm.; but toward each side this increases to 19 mm. The lines of growth of the first marginal scutes are very conspicuous on this surface. On the upper side of the bone the nuchal scute is observed to be 9 mm. long, 3 mm. wide in front, 10 mm. wide behind, and to be more deeply notcht posteriorly than in the type. The piece of xiphiplastron is very flat on the under side and has the free border acute. The beveled surface on the upper side is 11 mm. wide and ornamented with the growth lines of the femoral scute. There was a notch in the hinder end of the lobe.

No. 6019 is the epiplastron of a considerably smaller individual than the type. It differs especially in having the upper surface of the lip less swollen, the greatest thickness being only about 6 mm. This surface shows the lines of growth of the gulars.

No. 6020 furnishes a portion of the epiplastral lip and a fragment of the hyoplastron. The individual seems to have been slightly larger than the type. The upper surface of the lip is strongly folded. The fragment of hyoplastron belongs behind the entoplastron and is represented in fig. 360. Its thickness is only about 4 mm. The pectoro-abdominal sulcus crost it about 8 mm. in front of the hyohypoplastral suture.

C. morrisiæ resembles in some respects *Echmatemys pusilla*, especially in the epiplastral lip. For differences see the last-named species.

This species is named in honor of Mrs. Lindsey Morris Sterling, in recognition of the skill, accuracy, and artistic taste shown by her in the preparation of the great majority of line drawings in this work.

Clemmys hesperia Hay.

Plate 45, figs. 4–7; text-figs. 361–365.

Clemmys hesperia, HAY, Bull. Geol. Dept. Univ. Calif., III, 1903, p. 238, figs. 1–5.

As the type of this species, is taken the bone bearing number 2219 of the Paleontological Department of the University of California. This is the left hyoplastron, having the outer posterior portion, which enters into the bridge, missing. Plate 45, fig. 4, and text-fig. 361, represent it of the natural size and viewed from below. The sutural edges are present which met the hyoplastron of the opposite side, the postero-lateral border of the entoplastron, the hinder extremity of the epiplastron, and the front of the hypoplastron. As will be observed, the humero-pectoral sulcus, represented by a dotted band, crosses the entoplastron, while the pectoro-abdominal sulcus is well back on the hyoplastron. The structure of these parts is identical with that of the genus *Clemmys*, represented to-day on the Pacific Coast by *Clemmys marmorata*. The free border of the bone between the humeral buttress and the epihyoplastral suture is acute. The bone thickens until it reaches a thickness of 7 mm. where the suture just named meets the entoplastron. At the inner posterior angle the bone is only 3 mm. thick.

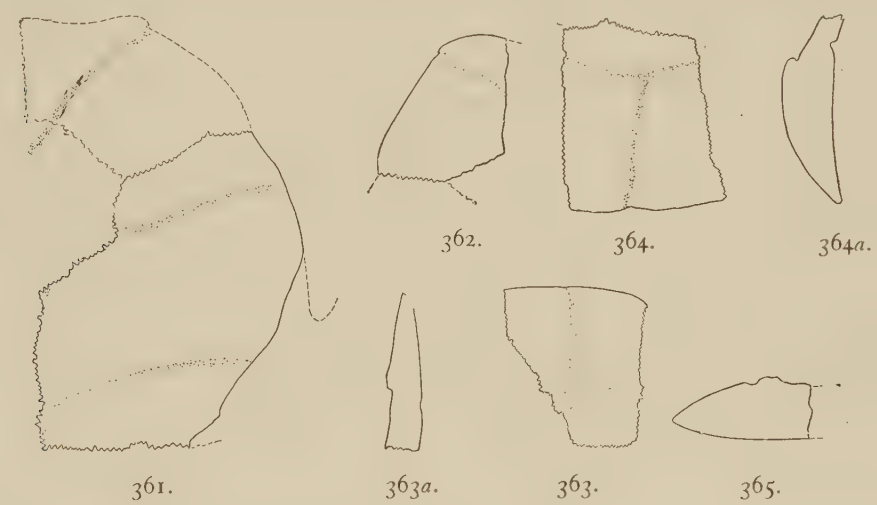
In lot No. 2179, believed to be from the Rattlesnake beds of the Pliocene but possibly from the Mascall beds of the upper Miocene, there is a portion of a left hyoplastron which lacks the free border, but which as far as it is represented is identical with the specimen above described. The writer regards it, therefore, as belonging to the same species and to the same formation. In this lot are included also a portion of the right epiplastron (plate 45, fig. 5; text-fig. 362), the first right peripheral bone (plate 45, fig. 6; text-fig. 363), a right peripheral, apparently the eighth or ninth, and some other fragments. The epiplastron has the

border which joined its fellow of the other side missing, so that it is impossible to determine accurately the width of the anterior lip of the plastron. However, this bone has been used in making the restoration of the front of the plastron, as seen in fig. 361. Plate 45, fig. 5, and text-fig. 362 show this bone as seen from below. It resembles closely the same bone in *C. guttata*, except that its upper side was not so deeply excavated as in the latter species. According to the restoration the lip had a breadth of about 34 mm.

The free borders of the epiplastron are subacute. Seen from the side, this border runs forward to the gulo-humeral sulcus and then turns rather abruptly downward, forward and inward. From the acute edge the bone thickens rapidly, until a thickness of 7 mm. is attained. The gulo-humeral sulcus probably continued backward on the entoplastron.

A piece of the thickened border of the xiphiplastron of this specimen is present. It extends from the junction with the hyoplastron to just behind the femoro-anal sulcus. Most of the free edge is broken away, but enough remains to show that it was acute. It thickens gradually until, at the inner border of the surface above, which was covered with horny skin, the thickness is 6 mm. The femoro-anal sulcus comes to the free edge 19 mm. behind the anterior end of the bone.

Plate 45, fig. 6, and text-fig. 363 present a view of the first right peripheral, both from above and from the right-hand edge, which joined the second peripheral. The left-hand border



FIGS. 361–365.—*Clemmys hesperia*. Portions of shell. ×1.

361. Left hyoplastron of type. No. 2219 Univ. California. The epiplastron is restored.
362. Portion of right epiplastron. ×1. No. 2179 Univ. California.
363. First right peripheral, with section (*a*). ×1. No. 2179 Univ. California.
364. Probable ninth peripheral, with a section (*a*). No. 2179 Univ. California.
365. Section of free border of hypoplastron. No. 5527 Univ. California.

joined the nuchal. The first peripheral resembles closely that of *C. guttata*. It will be observed that the outer anterior angle of the first vertebral scute extends outward on the bone here described and comes into contact with the second marginal scute. We have the same arrangement here that we find in *C. leprosa*, as shown by fig. 30, page 102, of Boulenger's Catalogue of Chelonians. This indicates that the first vertebral scute was broader than it is in *C. guttata*. The peripheral mentioned above, probably the ninth of the right side, resembles somewhat that represented by plate 45, fig. 7, and text-fig. 364; but it is shorter antero-posteriorly and higher, the fore-and-aft dimension being 15 mm., the height 19 mm. The longitudinal sulcus runs closer to the upper border than in fig. 364. The figure just referred to presents a view of the left ninth peripheral of an individual somewhat larger than the one just described. It is part of a lot numbered 552, from either the Mascall or the Rattlesnake beds. Fig. 364 shows the upper surface and the anterior end of the bone. Accompanying this bone there is the hinder outer angle of the hypoplastron, extending from the suture with the xiphiplastron to the inguinal buttress. A view of a section of the bone near the xiphiplastral suture is

shown in fig. 365. It is possible that this lot was derived from the Mascall beds and does not belong to this species.

From a comparison of the bones above described with the corresponding parts of *C. guttata* it appears that the carapace of *C. hesperia* attained a length of 5 or 6 inches. Unfortunately, the writer has not been able to compare the fossil species with *C. marmorata* of the Pacific Coast.

From the Rattlesnake beds of the Pliocene, Rattlesnake Creek, Oregon.

Clemmys saxea Hay.

Plate 45, figs. 8–10; text-fig. 366.

Clemmys saxea, HAY, Bull. Geol. Dept. Univ. Calif., III, 1903, p. 241, fig. 6.

This species is founded on rather meager materials, being represented by only 2 bones, the pygal and a posterior peripheral. These bear the number 2192 of the museum of the University of California. They were collected from the Mascall beds of the upper Miocene on Beaver Creek, near Crooked River, Oregon.

The pygal originally taken as type of the species is represented by plate 45, figures 8, 9 and text-fig. 366. These figures present views of the bone seen from above, from below, and also as seen from the sutural edge; and therefore both the size and the thickness of the bone are indicated. It has an antero-posterior length of 18 mm. and a width of 22 mm. at the anterior end and of about 10 mm. at the posterior end. The greatest thickness is 6 mm. On the superior surface the bone is convex; on the inferior surface it is concave. The sulci bounding the dermal shields are deeply impressed. The one between the last vertebral scute and the supracaudal scute lies well down on the bone, as in *C. guttata*. In *C. leprosa*, according to Dr. Boulenger's figure, this sulcus lies on the penultimate pygal bone. This bone is of rather peculiar form and will doubtless be easily recognized when additional materials have been discovered.

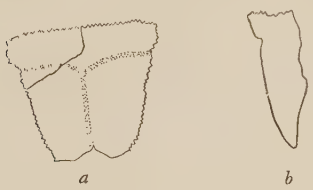


FIG. 366.—Pygal of *Clemmys saxea*. Type. ×1.

a, outer view; *b*, section.

The peripheral accompanying this pygal (plate 45, fig. 10), the tenth of the left side, resembles the one represented by fig. 7, but is smaller, and the horizontal sulcus has evidently run very close to the upper border, as it does in the corresponding bone of *C. leprosa*. Near the hinder end of the upper edge of the bone is a deep pit for the end of a rib.

It is possible that the bones described under *Clemmys hesperia*, belonging to Nos. 2179 and 552, belong to this species, there being some doubt regarding the level in which they occurred.

Clemmys? percrassa Cope.

Clemmys percrassa, COPE, Jour. Acad. Nat. Sci. Phila. (2), XI, 1899, p. 194, plate xviii, figs. 1–1*g*.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1903, p. 449.

The described specimens of the present species are in the collection of the Philadelphia Academy of Science, except that bone which is represented by Cope's fig. 1*e*, and except apparently also those bones called by him "No. 3." All these bones were found in the Pleistocene deposits of Port Kennedy Cave, in Montgomery County, Pennsylvania. The described remains included parts of two, perhaps of three, individuals.

That bone which is called by Cope his "No. 1" and which furnisht his fig. 1*b* must be regarded as the type of the species. This figure, like most of those of that paper, is poor and shows little more than the shape of the face figured. This bone includes a considerable portion of the right xiphiplastron. The figure presents the lower face of the bone. The hypoxiphiplastral suture forms the upper right border of the figure, while the free border of the bone is on the left. There is present a portion of the median longitudinal border. This makes an acute angle with the hypoxiphiplastral suture, but the size of the angle can hardly be determined. The thickness of the bone here is 9 mm. or 10 mm. From this border the bone thickens slowly along the hypoxiphiplastral border a distance of 30 mm; then it rapidly rises to the summit of a wall along the free border. The outer face of this wall is nearly perpendicular and

the summit is 18 mm. above the lower face of the bone. Backward, the wall descends, so that at the femoro-anal sulcus it is only 10 mm. high and its outer face is not so steep. The length of the hypoxiphiplastral suture is 51 mm. The femoro-anal sulcus reaches the free border of the bone at a distance of 30 mm. behind the anterior border.

The originals of Cope's figs. 1*c*, 1*f*, and 1*g* are portions of the central region of the plastron. They are about 5 mm. or 6 mm. thick.

Cope's fig. 1 represents what to the present writer appears to be the right eighth peripheral. It resembles greatly the corresponding bone of *Testudo tabulata*. The following are the measurements of the bone:

	Millimeters.
Length along the free border	28
Length along the sutural border supposed to join the ninth peripheral	42
Greatest thickness of this border	12
Length along sutural border supposed to join the seventh peripheral	37
Greatest thickness of this border	15

Cope's statement that the greatest thickness is 11 mm. is an error. The border regarded as the posterior is convex in outline. Cope thought that this was the anterior border. The free border (on the left of Cope's figure) is acute. The costal border is thickened, rounded, and smooth. Evidently it formed no interlocking suture with the costal bones. The sulcus (faintly seen in Cope's figure) turns slightly forward at the free border of the bone. In the thinner articular border there is a rough groove which received a ridge on the face of the ninth peripheral. On the supposed anterior articular face is a ridge to fit into the next bone.

Cope's fig. 1*d* represents another peripheral. The free border (on the left of Cope's figure) is acute and 27 mm. long. One sutural border (the lower of the figure mentioned) is 15 mm. thick and 36 mm. long. The opposite border is somewhat damaged but was evidently thinner. In the thicker articular face there is a groove instead of a ridge. It is not improbable that this is a second peripheral.

The bone represented by Cope's fig. 1*a* is difficult of identification on account of its damaged state of preservation. Cope speaks of it as "a piece of the inguinal marginal, which shows that this species has the fixed anterior lobe of the Emydidæ." Instead of inguinal he probably meant axillary. Quite certainly the bone belongs in either the axillary or the inguinal region. The form and the great thickness of the border of the hinder lobe and the smooth costal borders of the peripherals render it probable that this is rather a species of *Testudo* than of *Clemmys*.

Clemmys insculpta (Leconte).

Testudo insculpta, LECONTE, Lyc. Ann., New York, III, 1830, p. 112.
Clemmys insculpta, BOULENGER, Cat. of Chelonians, 1889, p. 107.—COPE, Jour. Acad. Nat. Sci. Phila. (2), XI, 1899, p. 194.

Professor Cope, as cited in the synonymy, reports the finding of some bones, referred to this species, in the Port Kennedy Cave, Pennsylvania. The remains were very fragmentary, and there is a possibility that they may belong to some related but undescribed species. *C. insculpta* is yet a living species in the eastern United States.

Genus ECHMATEMYS Hay.

Shell emydoid. Neural plates mostly hexagonal, with the broad end forward. Pygal bone short, the transverse sulcus crossing above it on the last suprapygal. Plastron suturally articulated with both the peripherals and the costals. Axillary buttresses rising above the border of the first costal and articulating with its inner surface. Inguinal buttresses ascending above the peripherals and articulating with the inner surfaces of the fifth and sixth costals. Usually a well-developt epiplastral lip. Humero-pectoral sulcus usually crossing the entoplastron. Skull not certainly known, but almost certainly emydoid in general structure and with the triturating surface of the upper jaw narrow and with no ridge, or a rudimentary one, on each side. Choanæ well forward. Lower jaw with a narrow triturating surface.

Type: *Emys septaria* Cope.

This genus is known principally from the Bridger Eocene, but also from the Wasatch and the Uinta.

In the absence of definite knowledge regarding many parts of the anatomy of the Eocene Emydidæ they have been usually, tho sometimes provisionally, referred to the genus *Emys*. More recently they have been supposed to belong to the North American genera *Chrysemys* or *Clemmys*. The writer has exprest himself to this effect in 1902 (Bibliog. and Cat. Foss. Vert. N. A., p. 447) and again in 1905 (Amer. Geologist, XXXV., p. 332). Recently there has come into the possession of the American Museum of Natural History a considerable number of shells of Emydidæ, especially from the Bridger deposits. Most of these specimens are somewhat damaged, but the majority of them are in condition to furnish abundant information. Unfortunately no skulls accompany these remains. A single dentary bone only was found in company with a good plastron and some fragments of the carapace. A study of these and other accessible materials has demonstrated that most of the Bridger species of Emydidæ belong to a hitherto unrecognized genus, *Echmatemys* (Hay, Bull. Amer. Mus. Nat. Hist., XXII, 1906, p. 27), the essential characters of which are the strongly developt buttresses and the feebly developt crushing surfaces of the jaws. In the existing North American genera of Emydidæ the buttresses rise little, if at all, above the lower borders of the costals with which they come into contact. In Asia there are, according to Boulenger, four genera which possess greatly developt axillary and inguinal buttresses, the latter articulating with the fifth and sixth costals. All of these genera differ, however, from *Echmatemys* in having the triturating surfaces of the jaws broad, and those of the maxillæ furnisht with one or two longitudinal ridges. The Eocene genus appears therefore to be well separated from both the American and the Asiatic forms.

The degree of development of the buttresses of *Echmatemys* appears to differ among the various species. It is doubtful whether in any of them the buttresses ascend so high within the carapace as they do in the Asiatic species. In *E. wyomingensis* the bases of the inguinal buttresses begin to rise perceptibly from the upper surface of the plastron at a point less than half-way from the free border of the hinder lobe to the midline. In *E. arethusa* they spring from the general level of the plastron at points about half-way between the border mentioned and the midline. In other species they rise still nearer the midline. There appears to be less variation in the width of the bases of the anterior buttresses. In *E. wyomingensis* these buttresses ascend but little above the lower border of the first costals. In other species they ascend half-way to the neural border of the costals. We find the same differences of development in the case of the inguinal buttresses, the height to which they ascend varying from half-way to two-thirds or more of the distance from the lower to the upper border of the costals concerned.

The presence of these buttresses results in the production of a deep sternal chamber on each side. In a specimen of *A. septaria*, the width of whose carapace is 225 mm., the width of the space between the inguinal buttresses is only about 80 mm.

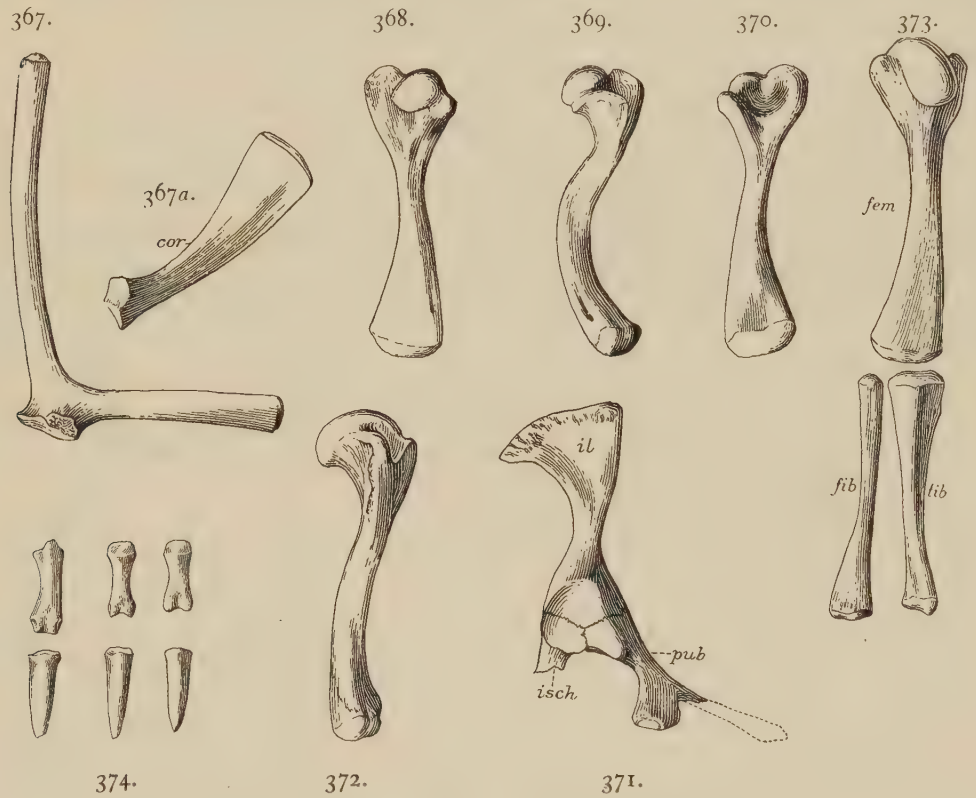
The existence of these buttresses in *E. septaria* was recognized by Professor E. D. Cope (Vert. Tert. Form. West, p. 130). In the case of his *Emys shaughnessiana* they were regarded as less well developt. On the contrary, the present writer finds that they were quite as broad and high as in *E. septaria*.

The determination of the species of this genus offers great difficulties. There is among them a great sameness in structure and general appearance. Few of them are markt by trenchant characters. Yet there exist differences that we can not overlook. Had we the skulls belonging to the shells in our possession, we might be relieved of some of our embarrassment; but for the present we must be content with the knowledge and the conclusions that we can derive from the carapaces and the plastra.

Another difficulty arises from the fragmentary character of the materials on which some of Dr. Leidy's species from the Bridger were establisht. If it is difficult to identify species when we have practically whole shells, it is far more difficult when we have only a fragment—for instance, the epiplastral lip or a fragment of the carapace.

In studying the materials in his hands the present writer has been compelled to recognize several new species. It is not unlikely that in some cases he has erred; but it has appeared to him that, better than the lumping together of forms which seem to be distinct, is their separation under special names, with careful descriptions, leaving to future writers, in the possession

of more and better materials, the determination of the value of these species. In establishing these species the writer has drawn on all the structures that appeared to offer assistance, the general form of the shell, the proportions of its various regions, the degree of the development of the buttresses, the forms of the neural bones, the form of the epiplastral lip, the form and size of the various scutes, etc. The condition and the variations of the same structures in various living species have been examined. As a result of this study it is to be recognized that in all the characters there is more or less fluctuation. We are often left in doubt whether the next specimen examined will not contradict the conclusion just formed. It will require the examination of many specimens to determine the range of the variations. It will be observed that there exist considerable differences among the forms of the vertebral scutes, these being in some cases relatively narrow and with parallel sides, in other cases relatively broad and



FIGS. 367–374.—*Echmatemys sp. indet.* Portions of skeleton. No. 11,525 Princeton University.
FIGS. 367–373, ×⅔, 374, ×1.

367. Scapula and 367*a* coracoid.
368. Right humerus, dorsal surface.
369. Right humerus, radial border.
370. Right humerus, ventral surface.
371. Pelvis, right side.
372. Right femur, tibial border.
373. Right femur, tibia and fibula, dorsal surface.
374. Terminal and penultimate phalanges.

with perhaps strongly bracketed sides. It is believed that some considerable reliance may be placed in these forms as indicating specific differences. Little aid in the differentiation of the species has been derived from the proportions of the plastral scutes. The usually well-developt axillary and inguinal scutes seem to offer valuable characters. Sometimes the axillary scutes extend backward and join broadly the fifth marginals; in other cases they fall far short of these marginals. In some forms the inguinal scutes articulate with the sixth marginals, while in others they lack much of attaining the marginals mentioned.

As already stated, little is certainly known about the skulls of the members of this genus. In the collection of fossil reptiles belonging to Princeton University there is a portion of a skull of an emyd that in all probability belongs to some species of this genus. It is represented by figs. 11, 12 and 13 of plate 45. It resembles much the skull of *Chrysemys picta*, altho larger. It differs especially in having the longitudinal ridge on the triturating surface of the maxilla

still less developt than in *Chrysemys*. The dentary bone of *E. wyomingensis* (figs. 398, 399) agrees well with the maxilla of this skull.

Text-figs. 367–374 represent various parts of the skeleton of the same individual.

It is evident that this genus began its existence at least as far back as the Wasatch. An examination of Cope's *Emys lativertebralis* (Wheeler's Surv. 100 Merid., IV, part ii, plate xxviii, figs. 1, 2) shows that it possest strongly developt inguinal buttresses, which articulated with the visceral surfaces of the fifth and sixth costals. The genus continued apparently until the middle of the Uinta, as evidenct by the presence there of *E. callopyge* and *E. uintensis*.

We are unable to determine as yet the relationships of this genus to *Kachuga*, *Callagur*, *Batagur*, and *Hardella*, of Asia. It seems possible that some species of *Echmatemys* made its way to that continent from America and thru a modification of its jaws gave origin to these genera.

Key to the Described Species of Echmatemys.

A^1. Wasatch and Green River species.
- a^1. No dorsal keel.
  - 1. Neurals broader than long; gulo-humeral sulcus crossing behind entoplastron; gular scutes reaching entoplastron ..... *lativertebralis*
  - 2. Neurals unknown; gular scutes not reaching the entoplastron; gulo-humeral sulcus crossing on entoplastron ..... *cibollensis*
  - 3. Sulci of carapace deeply imprest; costals swollen just outside of costo-vertebral sulci; bones thick and heavy ..... *testudinea*
  - 4. Bones rather thin; beveled surface on upper side of hinder plastral lobe narrow.. *euthneta*
- a^2. A dorsal keel; bones of carapace deeply imprest by sulci; bones thin ..... *megaulax*

A^2. Bridger species.
- a^1. Inguinal buttresses not extending half-way from free border of hinder lobe to midline.
  - 1. Vertebral scutes and neural bones considerably longer than wide ..... *wyomingensis*
  - 2. Vertebral scutes and neural bones wider than long ..... *pusilla*
- a^2. Inguinal buttresses reaching half-way from free border of hinder lobe to midline.
  - b^1. Third vertebral scute about seven-tenths its length.
    - 1. Fourth neural octagonal ..... *haydeni*
  - b^2. Third vertebral about eight-tenths its length.
    - 2. Third vertebral about 0.78 its length; anterior lobe not expanded.... *stevensoniana*
    - 3. Third vertebral 0.80 its length; anterior lobe of plastron expanding in front of axillæ ..... *septaria*
    - 4. Third vertebral about 0.81 its length; epiplastral lip contracted, tootht.... *arethusa*
    - 5. Third vertebral 0.82 its length; axillary buttress rising high; marginal scutes not high on anterior peripherals ..... *cyane*
    - 6. Third vertebral 0.82; humero-pectoral sulcus crossing behind entoplastron; free borders of shell in front obtuse ..... *shaughnessiana*
  - b^3. Third vertebral about nine-tenths its length or more.
    - 7. Third vertebral 0.87 its length; second vertebral still wider; anterior marginals rising high on peripherals ..... *ocyrrhoë*
    - 8. Third vertebral 0.97 its length and urn-shaped; sulci not in deep valleys; axillary scutes not reaching the fifth marginal ..... *ægle*
    - 9. Third vertebral as wide as long; the sulci of carapace in deep valleys; axillary scutes broadly joining fifth marginals ..... *naomi*
- a^3. Little known species; said to have a very wide epiplastral lip and a deeply notcht plastron ..... *latilabiata*

A^3. Uinta species.
- a^1. Vertebral scutes urn-shaped, the first narrower than the others ..... *callopyge*
- $a.^2$ Vertebrals with straight sides; the front the widest ..... *uintensis*

Echmatemys lativertebralis (Cope).

Text-figs. 375–378.

Emys latilabiatus, Cope, Syst. Cat., etc., Report to Engineer Dept. U.S. Army, 1875, p. 36; Ann. Report Chief Engineers, 1875, App. LL, p. 1016, of reprint, p. 96. Not *E. latilabiatus* of 1872.

Emys lativertebralis Cope, 1877, Wheeler's Surv. West 100th Merid., IV, part ii, p. 53, plate xxvii, figs. 1–3; plate xxviii, figs. 1, 2; Amer. Naturalist, XVI, 1882, p. 991, fig. 10; Vert. Tert. Form. West, 1884, p. 129.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

The known remains of this species were collected in the Wasatch beds of northern New Mexico and were at first referred by Cope to his species *Emys latilabiatus* of the Bridger beds. The specimens mentioned by Cope are at present in the U. S. National Museum and have been examined by the writer.

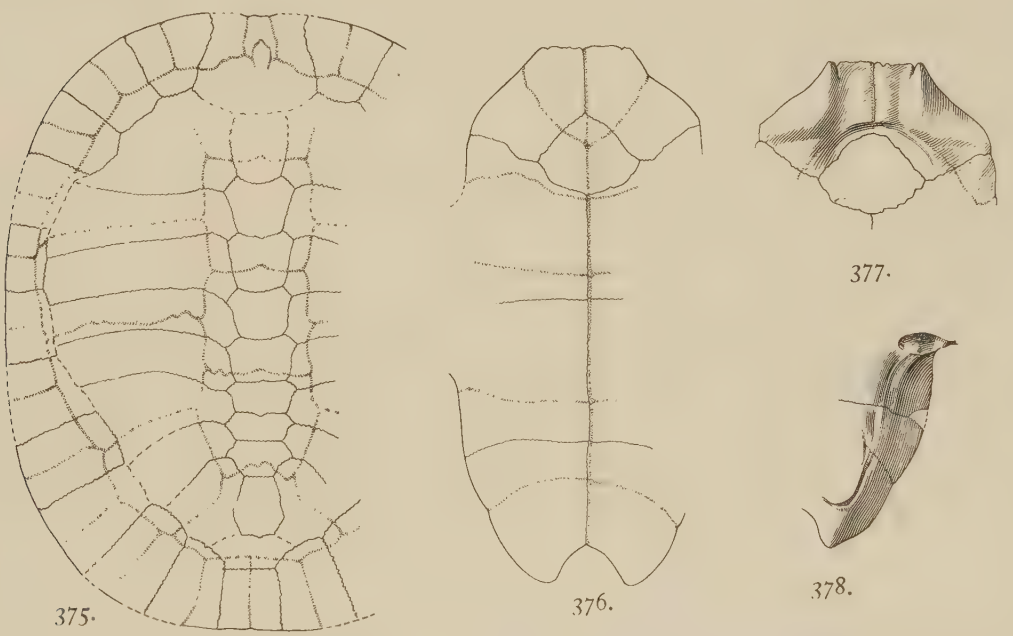
The type specimen, that figured by Cope, was restored from loose fragments, and various portions were missing. The length of the restored carapace (fig. 375) is given as 350 mm. It follows from this that Cope's figure is not half the size of nature, as is stated, but somewhat less. The width was close to 284 mm. The front was broad and rounded, the rear nearly truncate. The neurals are characterized by their great breadth as shown in the table herewith.

Neural.	Length.	Width.
1	..	..
2	28	36
3	30	34
4	26	36
5	25	37
6	19	39
7	14	40
8	22	37

The first suprapygal is 35 mm. long and 29 mm. wide.

On none of the neurals is there any trace of a median keel. The first pygal was 35 mm. long and 29 mm. wide. The second appears to have been about 21 mm. long and 49 mm. wide. The nuchal bone had a width in front of about 58 mm.

The costal bones presented no considerable differences in the widths of their opposite ends. They are devoid of sculpture. One of them, probably the third, had a width of 24 mm. in the middle of its length and a thickness of 5 mm. On the inner surface of the first and near to its peripheral border is a short articular surface for the reception of the axillary buttress. This surface shows that the buttress did not ascend so high as did that of some species of the genus. Above the scar for the buttress is a low ridge, that pertaining to the rib of the first costal.



FIGS. 375–378.—*Echmatemys lativertebralis*. Carapace and plastron of type. ×¼.

375. Carapace. Restored portions shown by interrupted lines. 376. Plastron. 377. Epiplastral lip, upper surface. 378. Right side and upper surface of hinder lobe of plastron.

The inguinal buttress articulated with the fifth and sixth costals. As stated by Cope and shown by the type, the buttress ascended about two-fifths the distance from the lower border of the costal to the upper border.

The free peripheral bones are large, thin, and recurved. The second and the eleventh are flared the most. The peripherals of the bridge were not crost by a sharp keel running from the anterior to the posterior free peripherals, a condition regarded as showing that the shell was not deprest. The first peripheral had a length of 48 mm. along the free border. Its

height, or extent at right angles with the free border, was about 45 mm. The eighth peripheral had a length along the free border of 41 mm. and a height of about 60 mm. The pygal had a height of 30 mm. and a width of 35 mm. It was moderately recurved and transversely convex above.

The sulci bounding the horny plates are well markt. Professor Cope describes the first vertebral scute as being longer than wide, the second as long as wide, the third a little wider than long, the fourth still wider; but a study of his figure does not in all respects confirm this statement. The dimensions in the accompanying table are estimated from his figure, as the bones of the carapace are now in a disturbed condition.

Scute.	Length.	Width.
1	60	68
2	62	64
3	60	62
4	50	67
5	52	95

The costo-marginal sulci have pursued their course considerably below the costo-peripheral sutures.

Professor Cope states that the length of the plastron (fig. 376) was 290 mm., and the specimen confirms the statement. He also informs us that the bones were not thick; but no measurements are given. The anterior lobe had a length of about 85 mm. and a width of about 140 mm. at the base. Cope's measurements are somewhat greater than those here given. The anterior lip projects somewhat beyond the general curvature of the lobe and is truncated. Seen from above the lip is very concave from side to side and spout-shaped (fig. 377). On each side is a rather deep cleft which separates from the remainder of the lip a rather prominent tooth. The thickening on the upper side of the lip extends backward about 35 mm. At the hyoepiplastral suture the beveled horn-covered surface has a width of about 25 mm.

The entoplastron has a length of 42 mm. and a width of 55 mm. Its thickness is 13 mm. The bridge is about 110 mm. wide.

The length of the hinder lobe is 105 mm., 85 mm. along the midline; its width is 140 mm. There is a posterior notch which has a width of 38 mm. and a depth of 20 mm. The beveled horn-covered surfaces on the upper side of the hinder lobe (fig. 378) have a width, at the hypoxiphiplastral suture, of 27 mm.

At the crossing of the median longitudinal and the hyohypoplastral sutures the bones are 10 mm. thick. The greatest thickness of the epiplastrals is 16 mm. The inner border of the beveled area, just behind the inguinal notch, is 13 mm.

The inguinal buttress begins to rise from the floor of the plastron at a line not quite halfway from the free border of the lobe to the midline.

The gular scutes are 53 mm. long; the humerals, 32 mm.; the pectorals, 41 mm.; the abdominals, 66 mm.; the femorals, 45 mm.; the anals, 34 mm.; all measured along the midline. The humero-pectoral sulcus falls slightly behind the entoplastron, resembling in this respect *E. shaughnessiana* (Cope). However, in one of Cope's specimens the sulcus crept over on the posterior margin of the entoplastron. It is not certain, on the other hand, that this specimen (Cope, Wheeler's Survey, IV, plate xxvii, fig. 3) belongs to the present species.

Cope collected altogether five specimens of this turtle, two of them larger than the type, and one much smaller. The latter showed traces of a median carina on some of the neurals.

Echmatemys cibollensis (Cope).

Text-fig. 379.

Emys (?)stevensonianus, Cope, Syst. Cat. Vert. Eocene New Mexico, Report to Engineer Dept. U. S. Army, 1875, p. 36.

Emys stevensonianus, Cope, Ann. Report Chief Engineers for 1875, Append. LL, p. 995 (of reprint, 75).

Emys cibollensis, Cope, Wheeler's Surv. W. 100th Merid., vol. IV, part ii, p. 57, plate xxvii, fig. 4; plate xxviii, figs. 3–6.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, pp. 447.

The figured specimen of the type of this species belongs to the U. S. National Museum and has the catalog number 2576. The carapace appears to be missing. Cope states that the species was based on a single imperfect individual, in which some of all the characteristic parts were present, except the neurals. Of the parts in his possession Cope figured the epiplastral lip, as seen from above and from below; the border of the hinder lobe, as seen from above; and two peripheral bones.

The type specimen was obtained from the Wasatch beds of New Mexico. The more exact locality is given as the Gallinas River.

In his great work on the Vertebrata of the Tertiary Formations of the West, publisht in 1884, Cope exprest the opinion that his *Emys cibollensis* may have been founded on a larger individual of his *Emys euthneta* of the "red beds" at Black Buttes, Wyoming. To the present writer, after comparing Cope's descriptions and figures and the types of the two forms and after study of such materials of *E. euthneta* as are accessible, Cope's opinion of 1884 seems erroneous, for reasons to be mentioned below.

The individual forming Cope's type was somewhat smaller than the one which formed the type of his *E. lativertebralis*. Its plastron was about 250 mm. long, carapace about 310 mm. When Cope described this species he regarded its relationships as being with his *Emys lativertebralis*, but he found the peripheral bones of the latter larger and thinner, and both the anterior lobe of the plastron and the entoplastron relatively longer.

Cope figures no costal bones, but he gives the width of one as 22 mm., the thickness as 6 mm. A costal of *E. lativertebralis* had a width of 24 mm. and a thickness of 5 mm.

Of the peripheral bones Cope says that they are not, or but little, recurved. He figures two of these, but he does not state whether they are anterior or posterior peripherals. Evidently both were imperfect. They probably belonged behind, and included the portion between the free border and the costo-marginal suture. Cope gives the length of one peripheral as being 30 mm. and its thickness as 9 mm.; but the thickness of those figured must have been about 12 mm. The peripherals of *E. lativertebralis* differ in being higher and thinner. On the other hand, the posterior peripherals of *E. euthneta* were more recurved.

The anterior lobe of the plastron to the hinder border of the entoplastron is 65 mm. long. The anterior lip (fig. 379) projected somewhat and is slightly concave in outline. At each side is a rather prominent tooth, but there is no cleft separating it from the remainder of the lip as there is in *E. lativertebralis*. The width of the lip, measured to the gulo-humeral sulci, is 54 mm. The thickening on the upper surface of the lip extended backward 23 mm. From each lateral tooth there extends backward a broad ridge. At the hyoepiplastral suture the beveled surface is 23 mm. wide. The entoplastron has a length of 36 mm., a width of 55 mm., and a thickness of 7 mm. As stated by Cope, the bone was transversely diamond-shaped. To the present writer, the epiplastral lip appears to be quite different from that of *Emys euthneta*.

FIG. 379.—*Echmatemys cibollensis*. Epiplastral lip of type. ×⅓. No. 2576 U. S. N. M.

The hinder lobe had a total length of 95 mm. and at the rear was a deep notch. There was a broad beveled area at the border of the upper surface, and at the hypoxiphiplastral suture this was 22 mm. wide. This surface appears to have been strongly imprest by the lines of growth of the horny scutes. In Cope's *Emys euthneta* this surface was relatively narrow (Vert. Tert. Form. West, plate xviii, fig. 42).

The estimate of the present writer is that the length of the anterior lobe of *E. lativertebralis* equaled 0.75 of the length of the hinder lobe; in *E. cibollensis* about 0.68.

The arrangement of the scutes of the anterior lobe of *E. cibollensis* is quite different from that of *E. lativertebralis*, since the gulars of the former do not reach backward to the entoplastron and the humerals overlap extensively this bone. The gulars of the present species had a length of 25 mm. and, taken together, a width of 54 mm. In *E. euthneta* the gulars had evidently a length fully equal to their combined widths.

There appears to be no good reason why this species should not be referred to *Echmatemys*.

Echmatemys? megaulax (Cope).

Plate 45, figs. 14, 15; text-figs. 380–383.

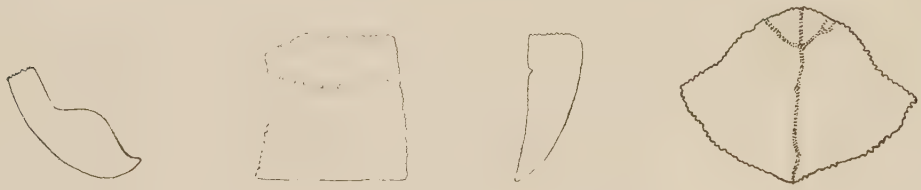
Emys megaulax, COPE, Sixth Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 628; Vert. Tert. Form. West, 1884, pp. 129, 132, plate xviii, figs. 26–33.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

Emys pachylomus, COPE, Sixth Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 629.

Professor Cope tells us that this species was based on fragmentary specimens of 5 or 6 individuals. Portions of these are now in the American Museum of Natural History, but the bones figured by Cope are in the U. S. National Museum at Washington, and have the catalog number 4061. The types and other specimens obtained by Cope were collected in the Green River beds of the Wasatch formation, at Black Buttes, Wyoming, in 1872. A note in Professor Cope's handwriting, accompanying some specimens at Washington, states that they were found in the first lignite beds of the Eocene at Black Buttes.

As stated by Cope, the markt peculiarity of the present species was the broad and abruptly sunken sulci which separated the epidermal scutes. There was a dorsal carina and this was conspicuously intersected by the sulci which crost it. The neurals are relatively broad. Cope gives the length of one as 17 mm. and the width as 18 mm. A neural in the American Museum, No. 1120, is 19 mm. long and 23 mm. wide at the broader end; its thickness at the border for the costal is 5 mm. Sometimes the carina is broader in front of the sulcus which crosses it and sometimes narrower. Sometimes (Cope's figure 32) the sulci are shallow. The neural which furnisht the figure just referred to has a thickness of 5.5 mm.; while the others figured are only about 4 mm. thick at the borders. Cope's fig. 28 does not represent a neural, but probably the hinder suprapygal. If so, the hinder marginal scutes extended upon it. The figure is inverted. Fig. 14, plate 45, is taken from No. 1184 of the American Museum. It is either the third or fifth neural.

The peripherals are rather thin, and they flare somewhat upward toward the free border. One figured by Cope (his plate xviii, fig. 29) had a width of 16 mm., a height of 23 mm., and



380. 381. 382. 383.

FIGS. 380–383.—*Echmatemys megaulax*. Peripherals and entoplastron. ×1.

380. Section across posterior peripheral. No. 1184 A.M.N.H.
381. Right third or left seventh peripheral. No. 1184 A.M.N.H.
382. Section of peripheral of fig. 381.
383. Entoplastron of type of *Emys pachylomus* Cope. Specimen in A.M.N.H.

a thickness of 5 mm. It appears to be either the eighth or the tenth of the right side. In the upper border is a pit for a rib. This, like others belonging to Cope's specimens, had the sulci deeply imprest. Cope's fig. 31 is almost certainly the first right peripheral and is quite different from the corresponding bone of *E. euthneta*, being 5.2 mm. thick where it joined the nuchal, while that of *E. euthneta* is 9 mm. thick. Cope's fig. 30 appears to be that of the second right peripheral, altho it does not join the first accurately. Fig. 15 of plate 45 is from a peripheral of lot No. 1184. Its breadth at the free border is 19 mm.; its height, 20 mm.; its thickness, 5 mm. At the free border the edge is rather abruptly turned upward. Another (text-fig. 380, section) is greatly thickened below the costo-marginal sulcus. Both of these are posterior peripherals. Text-figs. 381, 382 represent the right third or the left seventh peripheral. Its width is 17 mm.; its height, 19 mm.; the thickness of the anterior sutural border, 7 mm. On the inner face is a rough groove for the buttress. If this is the third peripheral it presents in its acute free border a great contrast to that of *E. testudinea*. The sulci are not broad and deep as they are in other posterior peripherals. It resembles other anterior peripherals in its moderate height.

There is little or no authentic material to throw light on the structure of the plastron of this species.

A lot of bones, including portions of more than one individual, probably of more than one species, bears Cope's label "*Emys pachylomus*, Black Buttes." Among them is an entoplastron which evidently is the one described by Cope in the Sixth Annual Report of the U. S. Geological

Survey, page 629. This bone (fig. 383) has a length of 23 mm., a width of 30 mm., and a thickness of 6 mm. It is quite certain that it does not belong with the other bones of the lot, all of which belonged to smaller turtles. In this lot are peripherals which belong to *E. megaulax*, having the scutal sulci deeply imprest. On some costals and a neural present they are not so deeply imprest. To the writer it appears that the peripherals are to be taken as the type of this supposed species, and that these belong to *E. megaulax*.

Cope (his plate xviii, fig. 33) has figured a costal bone, apparently the sixth of the left side. The thickness of the posterior border is only 2.5 mm. while that of the anterior border is 7 mm. This great thickness indicates that it united with the fifth costal to form a ridge for a strong inguinal buttress. For this reason the species is referred provisionally to *Echmatemys*. The proximal end of this costal shows that the sixth neural was short, 12 mm., at the costal border; also that the fifth neural was probably octagonal. On this costal just outside of the area of the fourth vertebral scute, there is a prominent boss.

So far as known at present, this species differs from *E. testudinea* in having the neurals keeled and the keel notcht at the crossing of the sulci; and in having the posterior peripherals thin and deeply and broadly imprest by the sulci. It must be stated, however, that little is known about the neurals of *E. testudinea* and little or nothing about the plastron of *E. megaulax*. It appears that the shell of *E. megaulax* was comparatively thin; that of *E. testudinea* rather thick and heavy.

Echmatemys testudinea (Cope).

Plate 45, figs. 16, 17; text-figs. 383–388.

Notomorpha testudinea, Cope, Proc. Amer. Philos. Soc., xii, 1872, p. 475.

Emys testudineus, Cope, Sixth Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 627; Wheeler's Surv. W. 100th Merid., iv, part ii, 1877, p. 58.

Emys testudinea, Cope, Vert. Tert. Form. West, 1884, pp. 129, 134, plate xxiii, figs. 12, 13.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

Professor Cope states that this species was represented in his collection by 4 or more individuals. These he secured in the Green River beds, as stated on his labels, 11 miles east of Evanston, Wyoming. These beds are a portion of the Wasatch formation. All the individuals collected by Cope were imperfect and fragmentary. Of his specimens he presented figures of only an entoplastron and the left border of the hinder lobe of a plastron seen from above. These figured specimens are now in the National Museum, at Washington, with the catalog number 4103.

In the Cope collection at the American Museum of Natural History there are several lots of turtle bones bearing Cope's labels stating that they are *Emys testudinea*. Besides lacking the figured specimens, these lots contain occasionally bones of more than one individual, and we can not always be sure that they do not include parts of other species. To add to the confusion, Cope's table of measurements (Tert. Vert., p. 135) can hardly be relied on; for while he gives the width of the plastron at the axilla as 86 mm., which is probably correct, he states that the length of the plastron from the axilla is approximately 50 mm. Whether this is an error or whether he referred to the anterior lobe alone, it is impossible to say. In that table the thickness of the hyoplastron at the entoplastron is said to be 99 mm. and at the hypoplastron as 5 mm., both of which statements are obvious errors. What the facts were we can only surmise.

In one lot, that bearing the American Museum's catalog number 1178, there are found the proximal ends of two costal plates, almost certainly the third and the fourth of the right side (plate 45, fig. 16). These are probably the ones mentioned by Cope in his description of 1884 as belonging to his second specimen. The fourth has a width of 17 mm., the fifth a width of about 20 mm. As stated by Cope, the sulci run in grooves. These grooves are broad, while the sulci themselves are very narrow. The surface of these costals is swollen just outside the sulci, forming what Cope has called a "hump." The thickness of the fourth thru this hump is 8 mm. Where this costal articulated with the neural the thickness is 7 mm., while that of the fifth is 8 mm. The rib-heads were not strongly developt. The external surface of these bones shows the lines of growth of the horny scutes. The sulci which limited laterally the second and the third vertebral scutes run at a distance from the neural border of only 5

mm. on the fourth costal and 6.5 mm. on the fifth. This indicates that these vertebrals were very narrow, probably about 30 mm.

No. 1181 has a label in Cope's handwriting which indicates that it is a portion of his principal specimen (Vert. Tert. Form. West, p. 134), but only a part of the bones described is present. Among these are portions of both the costals of the first pair. On the inner surface of each is a sutural scar for articulation with the axillary buttress. This is 5 mm. wide and on one of the pieces it is 17 mm. long, while the original length has been still greater. On page 143 of his Vertebrata of the Tertiary Formations of the West, Cope refers to certain bones which he had formerly described as xiphiplastrals and as showing that the pubis had articulated with the plastron. With this lot of bones is a rough drawing made by Cope which represents one of these costals as a part of the plastron. The bone (fig. 384) is, however, without doubt a costal, as Cope himself came to suspect. The outside of this costal shows strong concentric grooves produced during the growth of the first costal scute.

With the bones just described is what appears to be one of the hinder neurals. It is 16 mm. long, 17 mm. wide, and 7 mm. thick. The outer surface is rather rough. A fragment of the plastron, probably about its center, is 9 mm. thick. The right free border of the hypoplastron is represented by a fragment 23 mm. long. The edge is subacute. From this the bone thickens rapidly to the inner border of the beveled surface on the upper side, where it is 9.5 mm. thick. This surface is 15 mm. wide and is bounded interiorly by a sharp groove.

384. 385. 386.

FIGS. 384–386.—*Echmatemys testudinea*. Costal and plastral bones.

384. Distal end of right first costal, inner surface. ×2. No. 1181 A. M. N. H. Shows scar for axillary buttress.
385. Mesial portion of right hyoplastron. ×½. No. 1179 A. M. N. H.
386. Free border of hypoplastron, with section (*a*) at articulation with xiphiplastron. ×½. No. 1179 A. M. N. H.

No. 1179 may or may not all belong to the same individual, and the bones are probably another portion of Cope's principal specimen. The right hyoplastron (fig. 385) measures on the midline 46 mm. At the midline and where it joined the hypoplastrals the thickness is 13 mm., and 12 mm. where it joined the entoplastral. The femoro-abdominal sulcus crosses 33 mm. behind the entoplastron. The humero-pectoral sulcus can not be distinguisht. A fragment of the epiplastron has the free edge rather acute. The beveled surface is 16 mm. wide and has a maximum thickness of 9 mm. Fig. 386 represents the upper surface of the left free border of the hypoplastron and a section at the hypoxiphiplastral suture. The beveled area has a width of about 20 mm. and at the summit the bone is 13 mm. thick. It is limited on the inner side by a sharp groove. The beveled surface shows grooves produced by the scute—the femoral. A fragment of the left xiphiplastron shows that this was only 36 mm. long on the midline. There was evidently a posterior notch. At the anterior end of the median suture the thickness of the bone is 8 mm.; posteriorly it thins down to 4 mm.

No. 1179 includes likewise the proximal half of a costal, almost certainly the sixth of the left side (plate 45, fig. 17). The upper surface presents an elevation outside of the costo-vertebral sulcus, as in the case of those previously mentioned. Anteriorly this sulcus is removed 6 mm. from the neural border, but posteriorly it has receded to a distance of 13 mm. This indicates that the fourth vertebral expanded where the sulcus down the sixth costal departed.

The posterior border of the bone is 5 mm. thick, while the anterior sutural border is 8 mm. thick. This is due evidently to the formation of a ridge on the fifth and sixth costals for the reception of the inguinal buttress.

No. 1173 of the American Museum forms Cope's third specimen. There is present a portion of the first costal with the articular surface for the axillary buttress. There is a rough drawing by Cope on which this bone is traced as belonging to the xiphiplastrals. This bone belonged to a much larger individual than that represented by No. 1181, but the scar for the buttress is no longer. This costal was at least 35 mm. wide and is 7 mm. thick where it joined the first and second peripherals. The outer surface is smooth. With this lot is a portion of the third right peripheral, excavated at the hinder end to form a part of the sternal chamber. Fig. 387 represents the sutural surface which articulated with the second peripheral. It will be seen that the free border is broadly rounded. Fig. 388 presents the outlines and a view of the anterior articular surface of a hinder free peripheral. This is recurved and has an acute edge. The surface is uneven; and the sulci are narrow but sharply imprest.

No. 1258 appears to represent another portion of Cope's principal specimen. Among the bones is an entoplastron, but not the one described by Cope. The one which furnisht Professor Cope's figure 12 is not one-half the size of nature, as stated, but four-sevenths. The breadth of the entoplastron of No. 1258 is 37 mm., its antero-posterior extent 24 mm., 2 mm. less than that given by Cope. The longitudinal sulcus is very obscure, while the humero-pectoral plainly crosses the bone about the middle of the length. The internal face of the bone is badly weathered, so that little regarding the position of the bone can be determined therefrom. The anterior border is damaged for most of its extent. There is a piece of the left hyoplastron present, but it is impossible to say whether the two bones belong together. What appears to be the free border of the right hyoplastron is present. The edges are acute. The beveled surface on the upper side attains a width of 15 mm. and a thickness of 9 mm. Two portions of the epiplastra are present, but their proper positions are difficult to determine. They are acute-edged and they thicken rapidly, the beveled surface attaining a thickness of 11 mm. and a width of 14 mm. At the inner border the thickness is diminisht suddenly.

387. 388.

FIGS. 387 AND 388.—*Echmatemys testudinea*. Peripherals. ×1. No. 1173 A. M. N. H.

387. Section at anterior end of third right peripheral.
388. Hinder peripheral. Section to show thickness and curvature.

The fragment of the hinder lobe figured by Cope (his fig. 13) appears to indicate the presence of a well-developt inguinal buttress, whose base extended inward about 20 mm. from the free border. At the suture between hypoplastron and xiphiplastron the beveled upper border has a width of 15 mm. and here the bone is 8.5 mm. thick. The inner border of the beveled surface is bounded by a considerable groove. The free border is acute. The lower surface of this hinder lobe was flat transversely and turned up posteriorly. The abdomino-femoral sulcus crost the plastron somewhat in front of the inguinal notch.

Cope believed there was an undivided intergular, but the writer finds nothing to sustain this opinion, and it is improbable. Undoubtedly the species is an emyd, and the presence of an intergular, single or divided, would probably be unique. The proximal end of a costal, the second or the fourth of the left side, has a width of 20 mm. and a thickness of 8.5 mm. The longitudinal sulcus traverst the bone at a distance of 7 mm. from the neural border, showing again that the vertebral scutes were very narrow. While the surface is uneven, there is no swelling outside of the sulcus, differing thus from the others described.

Echmatemys euthneta (Cope).

Plate 46, fig. 1; text-figs. 389–391.

Emys euthnetus, COPE, Sixth Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 628.
Emys euthneta, COPE, Vert. Tert. Form. West, 1884, pp. 129, 133, plate xviii, figs. 34–42.—HAY, Bibliog. and Cat. Foss. Vert., 1902, p. 447.

This is one of the two species of emyd turtles described by Professor Cope from the Green River beds in the region of Black Buttes, the other species being *E. megaulax*. *Emys euthneta* is said to have been represented by numerous specimens and to have been abundant in the red beds which lie between those identified as belonging to the Green River and the Bridger epochs at Black Buttes. The figured bones of the species are in the National Museum at Washington. They have the catalog number 4125.

In the American Museum there are three lots, parts of the Cope collection, which appear to belong to this species. The parts which were figured by Cope were 3 neurals, 4 peripherals, 1 epiplastron, and a part of 1 xiphiplastron. All these, it is stated, were found together and were supposed to belong to a single individual. The neurals displayed no dorsal keel, the scutal sulci were not deeply impressed, and the surfaces of the carapacial bones were smooth. The length of the carapace of this individual must have been about 190 mm., the three neurals taken together measuring 49 mm. One neural, probably the third (Cope's fig. 34), had a length of 19 mm. and a width of 15.5 mm., and a thickness of 4 mm. The neurals were not so wide in proportion to their length as in *E. megaulax*. The peripherals resemble those of *E. megaulax*, but they were not so deeply impressed by the sulci. The peripheral represented by Cope's fig. 37 is apparently an anterior second. It is 8 mm. thick where it joined the third. Cope's fig. 38 appears to represent the ninth peripheral of the right side, while his fig. 40 shows probably the eighth of the left side. The border which articulated with the seventh is 7 mm. thick; that which articulated with the ninth is 6 mm. thick. Cope's figure of the epiplastron shows correctly that the lip projected abruptly for a short distance, and was little, if at all, notched at the midline. It is rounded off both above and below and has the free border obtuse. Its greatest thickness is 6 mm. It is doubtful how near the midline the fragment approached, so that the width of the lip is uncertain. The hinder lobe is broadly notched and the beveled surface on the upper side is relatively narrow. The thickness of the border is 5 mm. anteriorly. Here the free edge is obtuse but posteriorly it becomes acute.

In the Cope collection of fossil reptiles, in the American Museum of Natural History, there are four lots of bones which are labeled by Cope as having come from the "red beds" of Black Buttes and were regarded by him as belonging to his *Emys euthneta*. These bear the catalog numbers 1119, 1174, 1176, and 1182. Nos. 1176 and 1182 together present nearly the whole of the plastron, except the epiplastron and the entoplastron. No. 1182 furnishes most of the hyoplastron of the right side and most of the hypoplastron of the left side. These bones are relatively thin.

The plastron had a total length of nearly 240 mm. At the crossing of the median longitudinal suture and the hyohypoplastral suture the thickness is 7 mm. On account of some missing fragments, the length of the hyoplastron can not be exactly determined. The anterior lobe has a width of about 120 mm. The free border of the epiplastral process is acute, but soon the bone thickens to 8 mm. At the hyoepiplastral suture the beveled surface on the upper side is 10 mm. wide. No groove separates it from the surface beyond. The humero-pectoral sulcus, deeply sunken, crosses the free border of the bone 14 mm. behind the suture just mentioned. It appears almost certain that this sulcus did not touch the entoplastron. A deeply impressed sulcus cut off an axillary scute, only a part of which was situated on the hyoplastron. The pectoro-abdominal sulcus crosses the bone at a distance of 19 mm. in front of the hyohypoplastral suture, measured at the midline; measured at the free border of the bone the distance is 30 mm. This sulcus is narrow and shallow. On the upper side of the bone, on the outer two-fifths, a strong axillary buttress arises for articulation with the first costal.

The hypoplastron has a length of 70 mm. The width of the hinder lobe was close to 105 mm. The free border has an acute edge. The superior beveled surface has a width of 10 mm. at the hypoxiphiplastral suture. No groove intervenes between this surface and that beyond. At a distance of 20 mm. from the free border the thickness of the bone is 8 mm. The inguinal buttress rises from the upper surface of this bone at a line less than half the distance from the free border to the midline. The abdominal scutes of this individual had a length of about 58 mm. A fragment of the first costal (fig. 389) shows that the axillary buttress of this turtle ascended a distance of 20 mm. on the inner surface of the costal.

Specimen No. 1176 (plate 46, fig. 1) presents the nearly complete hypoplastron and the complete xiphiplastron. The individual was only slightly smaller than the preceding, the

hypoplastron having a length of 73 mm. The superior beveled border is 12 mm. wide. At the inner border of this surface the bone is 12 mm. thick. Beyond the bevel the bone thins somewhat. Near the hypoxiphiplastral suture a groove develops just inside the beveled surface. On the lower surface of the bone is seen the broad and deeply sunken abdomino-femoral sulcus, which crosses at a distance of 40 mm. behind the anterior border of the bone. The median longitudinal sulcus also has been broad and deep. There has been a large inguinal scute, part of which lay on the hypoplastron.

The xiphiplastron has a length of 44 mm. on the midline. Posteriorly there was a notch about 35 mm. wide and 10 mm. deep. The superior beveled surface (fig. 390, upper view and section at hypoxiphiplastral suture) is separated from that beyond it by a sharp groove. The greatest thickness of the bone, 11 mm., is at the summit of the bevel, but for some distance it diminishes little. At the midline it has become reduced to about 7 mm. The femoral scutes measured 50 mm. along the midline; the anals, 25 mm. The femoro-anal sulci are deep and wide.

No. 1119 furnishes, together with unimportant parts, a portion of the epiplastron, including the lip. Seen from above, it resembles greatly the one figured by Cope (his plate

FIGS. 389–391.—*Echmatemys euthneta.* Costal and plastral bones.

389. Inner surface of right first costal. ×1. Specimen in A. M. N. H. Shows scar for axillary buttress.
390. Portion of hinder lobe, upper surface, with section of free border. ×1. No. 1176 A. M. N. H.
391. Restoration of plastron. Mostly from Nos. 1176 and 1182 A. M. N. H.

xviii, fig. 41*a*). Seen from below, it is observed that the gular scutes could have extended backward hardly more than half-way to the entoplastron. The lip must have been at least 22 mm. wide. The whole free border of the bone was obtuse. The superior horn-covered surface is convex. Laterally the upper surface of the lip is swollen, and is about 7.5 mm. thick; but at the midline the thickness is reduced to 4 mm. The individual was a smaller one than either of those just described. A fragment of a fifth or sixth costal is thickened on one side for articulation with the sixth or fifth costal and has an articular surface for the inguinal buttress. A peripheral and some fragments of costals show that the sulci were rather deeply imprest.

Lot No. 1174 contains many fragments of more than one individual, possibly of more than a single species. Fragments of the fifth and sixth costals appear to indicate that the inguinal buttresses were articulated principally with the sixth costal.

Fig. 391 presents a restoration of the plastron from the various bones described. The epiplastral lip is taken from Cope's figure.

After the preceding descriptions and figures had been prepared 3 additional specimens of this species arrived at the American Museum of Natural History. These were collected in 1906 by the museum's expedition sent into the deposits of the Wasatch in Wyoming. They were all obtained on Bitter Creek, within about 20 miles of Black Buttes, where Cope obtained

his specimens. One of the new specimens, No. 6032, 215 mm. long and 175 mm. wide, furnishes the shell complete, with the exception of the proximal ends of some of the median costals and parts of two neurals. No. 6042, 270 mm. long and 227 mm. wide, furnishes a complete shell, but has the carapace crusht down on the plastron. No. 6043, somewhat smaller than No. 6032, is a nearly complete shell, lacking only a part of the rear of the carapace and the hinder extremity of each xiphiplastron.

In No. 6032 the third neural is octagonal, whereas in No. 6042 it is hexagonal. In both specimens the fifth is octagonal, the hinder angles being in contact with the sixth costals. In No. 6032 the sulci bounding the vertebral scutes are deeply sunken, and in many places these sulci are bordered by crimpt ridges. In No. 6043 also, all of the sulci are deeply sunken and included between ridges of the bone.

Vertebral.	No. 6032.		No. 6042.	
	Length.	Width.	Length.	Width.
1	42	53	51	63
2	42	38	48	40
3	47±	42±	50	39
4	40	49	47	49
5	45	55	49	68

The vertebral scutes have their sides more or less bracket-shaped. The dimensions of those of Nos. 6032 and 6042 are given in the accompanying table.

The anterior lobe of No. 6032 is 52 mm. long and 96 mm. wide at the base. The epiplastral lip is 40 mm. wide. Its anterior border is excavated somewhat, but in the other specimens it is truncated. The upper surface of the lip is concave from side to side. The horn-covered areas of the upper surface of this lobe are narrow. In all the specimens the entoplastron is wider than long. It is not crost by the humero-pectoral sulcus, altho in No. 6042 this sulcus skirts its posterior border. The bridge of No. 6032 is 80 mm. wide. The hinder lobe has a length of 68 mm. and a width of 94 mm. at the base. The notch in the rear is large, 45 mm. wide and 17 mm. deep.

No. 6043 presents the interior surfaces of carapace and plastron. The bases of the axillary and the inguinal buttresses extend inward only about a third of the distance from the free borders of the lobes to the midline. Each axillary buttress rises to a point about one-third the distance from the lower end of the first costal to the midline of the first neural. The inguinal buttresses are applied against the contiguous borders of the fifth and sixth costals and rise halfway to the midline of the carapace.

Echmatemys wyomingensis (Leidy).

Plate 47, fig. 1; text-figs. 392–403.

Emys wyomingensis, Leidy, Proc. Acad. Nat. Sci. Phila. 1869, p. 66; Ann. Report U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 367; Contrib. Ext. Fauna West. Terrs., 1873, p. 140, plate ix, fig. 5; plate x, figs. 1, 2.—Cope, Ann. Report. U. S. Geol. Surv. Terrs., 1872 (1873), p. 626.—Osborn, Scott and Speir, Contrib. Mus. Geol. and Arch. Princeton Coll., No. 1, 1878, p. 95.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

Emys jeanesi, Leidy, Proc. Acad. Nat. Sci. Phila. 1870, p. 123; Ann. Report U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 366.

Emys jeanesianus, Leidy, Amer. Jour. Sci. (3), II, 1871, p. 372.

Emys vyomingensis, Cope, Wheeler's Surv. W. 100th Merid., IV, 1877, p. 53; Vert. Tert. Form. West, 1884, p. 135, plate xxiii, figs. 9–11.

Chrysemys wyomingensis, Hay, Amer. Jour. Sci., XVIII, 1904, p. 267, plate xiv, text-figs. 3, 4.

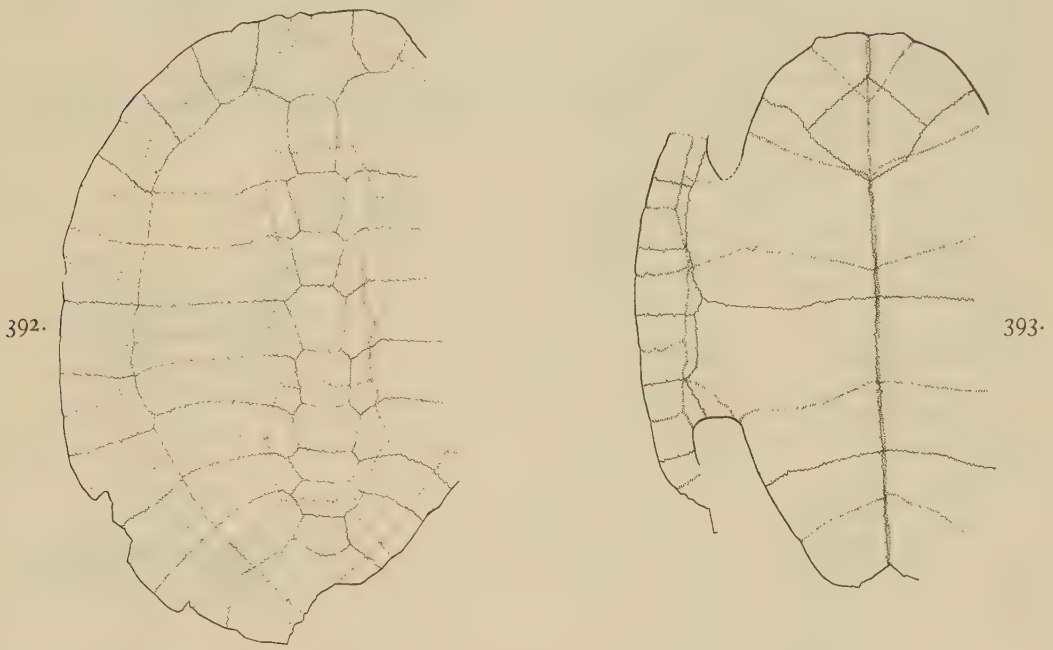
The present species was based by Dr. Leidy on an isolated left epiplastral bone which had been sent to him by Dr. J. Van A. Carter and which had been obtained from the Bridger beds somewhere in the vicinity of Fort Bridger, Wyoming. This bone is now in the collection of the Academy at Philadelphia. It shows that the epiplastral lip, from one gulo-humeral sulcus to the other, had a width of 60 mm. The anterior border is truncated, with a slight notch mesiad of the sulcus named, so that a blunt tooth is suggested. The whole free border is acute, least so just outside the sulcus. The median sulcus on the lower side apparently deviated slightly from the midline, and this caused Leidy to suppose that there had been present a narrow intergular scute. The thickness of the bone at the midline is 12 mm., and the same behind each of the lateral teeth. On the upper surface there is a broad low ridge running along the midline and on each side of this ridge a broad shallow groove. On this surface the gulo-

humeral sulci run directly backward. The bone is thickened backward a distance of 20 mm. The horn-covered band is 17 mm. wide at the hyoepiplastral suture.

In 1870, as cited above, Dr. Leidy described his *Emys jeanesi* from a quite complete shell found near Fort Bridger. In 1873 he referred this specimen to his earlier *E. wyomingensis*. An examination shows that its epiplastron is as nearly like that forming the type of *E. wyomingensis* as could be expected in two individuals of the same species. The width of that of *E. jeanesi* is 54 mm.; the thickness at the midline, 11 mm.; behind the lateral teeth, 12 mm. As in the type of *E. wyomingensis*, there is, on the upper surface, a broad longitudinal ridge flankt by broad grooves. The thickening of the upper surface extends backward about 20 mm. The width of the smooth band, at the hyoepiplastral suture, is 13 mm. There appears to be neither reason nor profit in regarding *E. jeanesi* as distinct specifically from *E. wyomingensis*.

The type of *E. jeanesi* was figured by Leidy. Diagrammatic figures are here presented of both carapace (fig. 392) and plastron (fig. 393).

An examination of the interior of the shell of this type shows that the inguinal buttresses were not so strongly developt as in most other species of *Echmatemys*. They arise from the



FIGS. 392 AND 393.—*Echmatemys wyomingensis*. Carapace and plastron of type of *Emys jeanesi*. ×¼. U. S. N. M.

392. Carapace. 393. Plastron.

floor of the plastron at a line two-fifths the distance from the free border of the hinder lobe to the midline. The distances are respectively 29 mm. and 69 mm. The width of the smooth band, on the upper surface, at the hypoxiphiplastral suture, is 12 mm. The greatest thickness of the bone here is 13 mm. The axillary scute is mostly missing, but it appears to have extended backward only to the middle of the fourth marginal. The inguinal scute too is short, reaching forward only to the middle of the seventh marginal.

No. 5988 of the American Museum furnishes the plastron complete and the carapace lacking peripherals 3 to 6 inclusive, of the right side, the distal ends of the 4 posterior costals of the same side, and the pygal. The specimen was obtained in 1903, on Little Dry Creek, Wyoming, and belongs to horizon B. The shell has been crusht downward after burial and the width considerably exaggerated. Both eleventh peripherals are present, but they stand apart about 90 mm., whereas in life they were separated only by a pygal about 20 mm. wide.

The surface of the shell was smooth. There is no suggestion of a median keel. The length of the carapace (text-fig. 394) was close to 335 mm. The width may be regarded as having

been about 250 mm. The anterior border is truncated. The free margins are nowhere notcht. The nuchal is 50 mm. long, 43 mm. wide in front, and 75 mm. where widest. Its anterior border, as well as that of the peripherals of the first pair, is acute. These bones are rather thin, only 11 mm. The anterior and the posterior neurals are relatively broad, the others narrow. The dimensions of the neurals are shown in the table.

Dimensions of the neurals.

No.	Length.	Width.
1	42	30
2	34	35
3	38.5	28
4	35	27
5	35	33
6	26	30.5
7	18	34
8	28	28

Dimensions of peripherals.

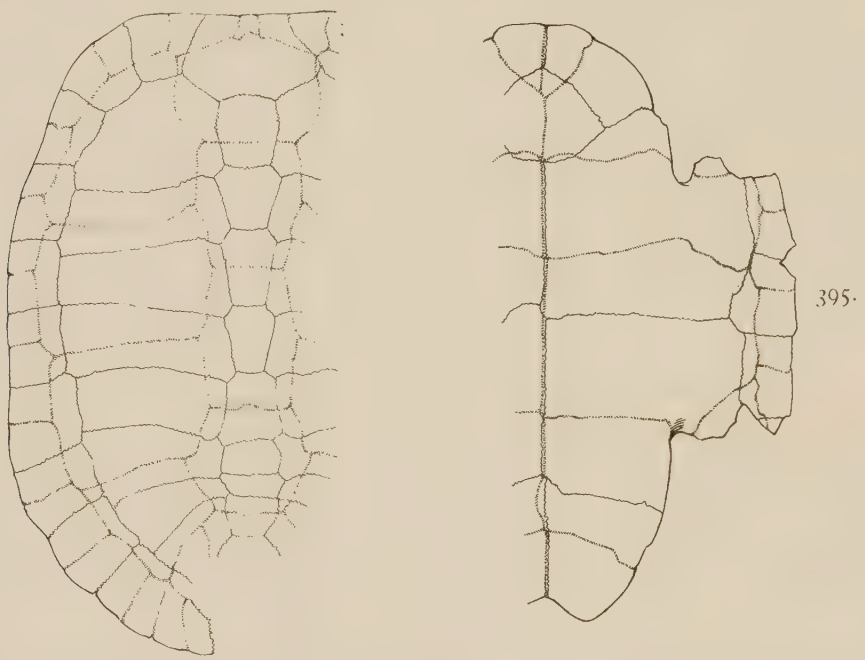
No.	Height.	Width free border.	Width costal border.
1	38	43	25
2	39	45	27
3	42	45	27
6	46	39	37
8	50	40	33

Dimensions of vertebral scutes.

No.	Length.	Width in front.	Greatest width.
1	64	75	78
2	68	49	56
3	74	37	53
4	72	44	66
5	..	35	90±

The fifth neural is octagonal, due doubtless to an individual variation. The first suprapygal is 22 mm. long and 33 mm. wide.

The costal plates are usually about as wide at the upper end as at the distal end. However, the third is 37 mm. wide proximally and 27 mm. distally. The third has a height equal to only



394. 395.

FIGS. 394 AND 395.—*Echmatemys wyomingensis.* Carapace and plastron. $\times\frac{1}{4}$. No. 5988 A. M. N. H.

394. Carapace. 395. Plastron.

41 per cent. of the height of the first costal near its hinder border. The posterior peripherals possess an acute free border. The first costal bone is hardly two-thirds as wide as high.

The dimensions of the peripherals are given in the table above.

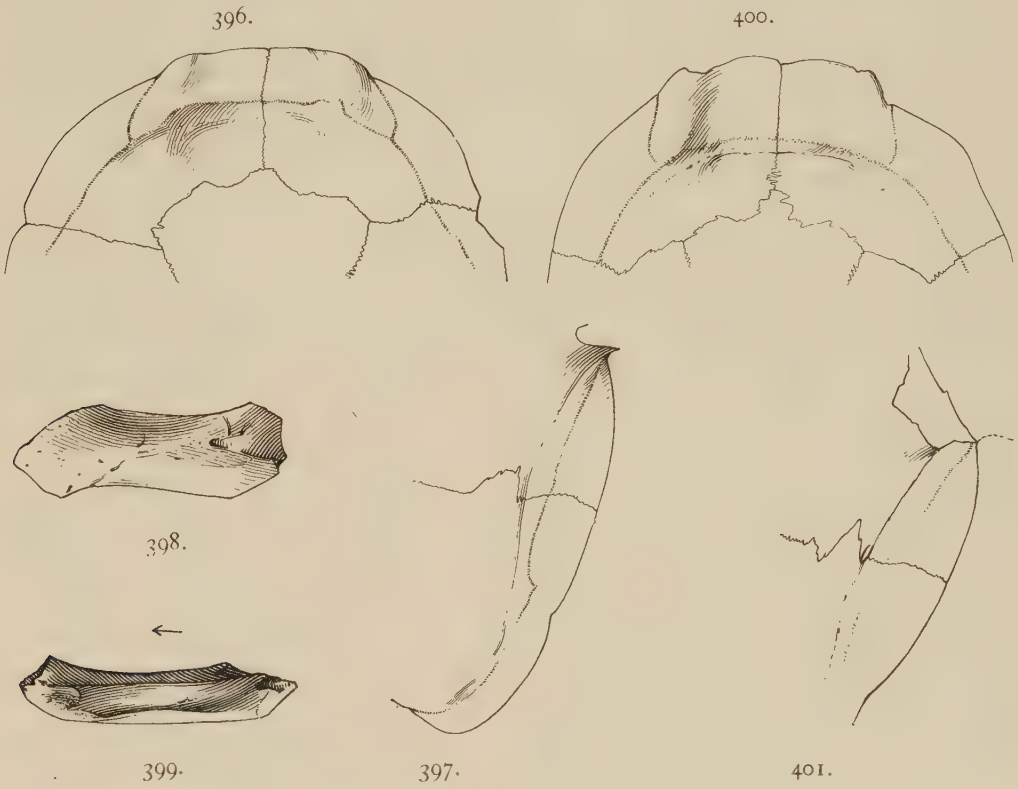
The sulci are narrow and rather shallow. The first and fifth vertebral scutes are broad, the others are narrow, with nearly parallel sides. The dimensions of the vertebral scutes are shown in tabular form above.

The costo-marginal sulci run about 16 mm. below the costo-peripheral sutures.

The plastron (plate 47, fig. 1; text-fig. 395) is 304 mm. long. It is thick, especially at the crossing of the longitudinal and the hyohypoplastral sutures. The length of the anterior lobe

is 82 mm.; the width, 143 mm. Thus the length is only 55 per cent. of the width. The epiplastral lip is 55 mm. wide and projects but little beyond the general curve of the lobe. The beveled surface on each side of the lip (fig. 396) on the upper surface of the bone is only 15 mm. wide and at the hyoepiplastral suture only 12 mm. The thickened portion of the epiplastrals above the lip extends backward only 16 mm., and where thickest, just mesiad of the gular sulci, only 15 mm. The free borders of the lobe are acute nearly to the lip.. The entoplastron is lozenge-shaped, 51 mm. long and 65 mm. wide. The bridge is 133 mm. wide.

The posterior lobe is 98 mm. long and 135 mm. wide, the length being thus about 73 per cent. of the width. The width is considerably less than the half of the length of the plastron. In the type of *E. jeanesi* the width is close to half the plastral length. Posteriorly in No. 5988 there is a broad notch. The beveled surfaces along the borders on the upper side (fig. 397)



FIGS. 396–401.—*Echmatemys wyomingensis*. Various bones.

396. Upper surface of epiplastral lip. ×½. No. 5988 A. M. N. H.
397. Upper surface of right side of hinder lobe of plastron. ×½. No. 5988 A. M. N. H.
398. Left dentary bone, outer surface. ×¾. No. 5968 A. M. N. H.
399. Same dentary as fig. 398, seen from above. ×¾.
400. Upper surface of anterior lobe. ×½. No. 6010 A. M. N. H.
401. Upper surface of free border of hinder lobe of plastron. ×½. No. 6010 A. M. N. H.

have a width of 18 mm. at the hypoxiphiplastral sutures. Here the thickness of the bones is 14 mm.

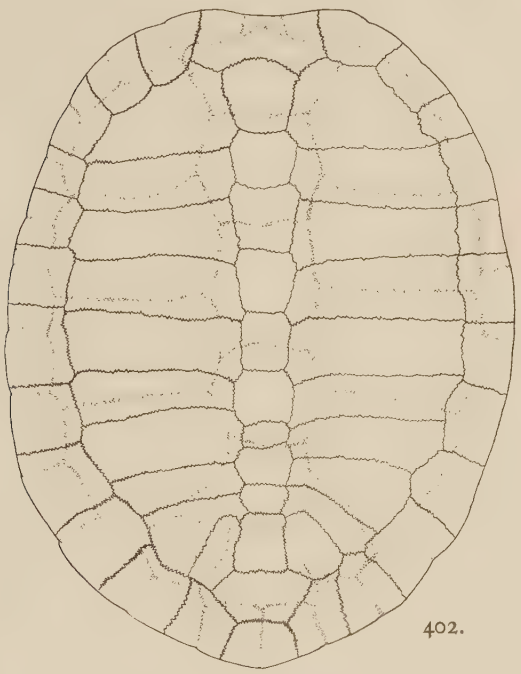
The gular scutes are 39 mm. long; the humerals, 36 mm.; the pectorals, 51 mm.; the abdominals, 84 mm.; the femorals, 58 mm.; the anals, 37 mm.; all measured along the midline. The axillary scute falls far short of reaching back to the fifth marginal; the inguinal comes forward nearly to the sixth marginal.

The posterior buttresses extend inward from the free borders of the hinder lobe little more than one-third the distance to the midline. Articulating with the fifth and sixth costals, they rise about 44 mm., to a point nearly half-way from the lower border of these costals to the bases of the rib-heads. The anterior buttresses appear to have risen about 20 mm. within the first costals.

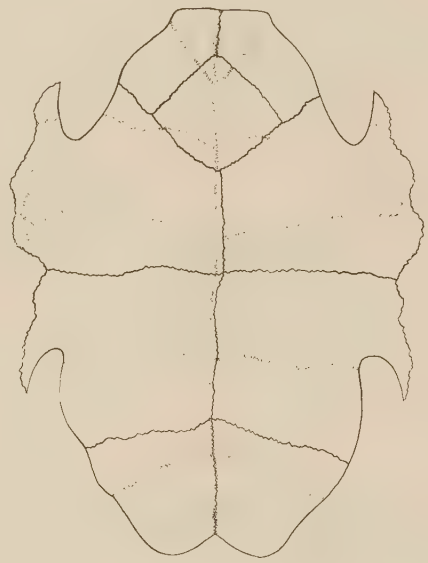
No. 5987 of the American Museum is referred to this species, altho it presents some important differences. It is represented by a damaged shell from Grizzly Buttes. Its size is almost exactly that of No. 5988. The carapace differs especially in having the costals modified so that their distal ends are alternately wider and narrower. The proximal ends are not present. The dimensions of the costals are shown in the table herewith.

Costal.	Width of distal end.
2	41
3	20
4	41
5	27
6	38
7	34
8	27

The plastron is thick and heavy, the thickness of the bones at the crossing of the longitudinal median suture with that between the hypoplastra and xiphiplastra being 18 mm. The anterior lobe has the same proportions as in No. 5988, but its width is slightly greater. The thickening on the upper side of the lip extends back 22 mm., thus being wider than in No. 5588, but the lip above and below resembles closely that of the type of *Emys jeanesi*. The hinder lobe is wider than in No. 5588, being 150 mm. The beveled surface on the upper side of the lobe has a width, at the hypoxiphiplastral suture, of 26 mm. The inguinal scute runs for a short distance between the



402.



403.

Figs. 402 AND 403.—*Echmatemys wyomingensis*. Carapace and plastron. $\times \frac{1}{4}$. Yale University Museum.

402. Carapace showing supernumerary neurals, costals, etc. 403. Plastron.

abdominal scute and the sixth marginal. It is possible that in this specimen we have a distinct species, but the differences are probably due to individual variations.

No. 5950 of the American Museum, collected in 1903, at Grizzly Buttes, Wyoming, presents a portion of both carapace and plastron, both badly crusht. The specimen is peculiar in the form of the first vertebral scute. This is longer than in No. 5988 and much narrower in front. The length is 77 mm.; the width in front, 60 mm. The lateral sulci bounding this scute meet the first marginals at the middle of the length of the latter.

No. 5968 of the American Museum was collected in the western portion of Grizzly Buttes. It furnishes a good plastron, various fragments of the carapace, some limb bones, and the right dentary. The plastron has a total length of 306 mm. The specimen is valuable on account of the dentary bone. It establishes the fact that the triturating surfaces of the jaws were smooth and very narrow. Fig. 398 represents the left dentary as seen from the side and fig. 399 as seen from above; both of the natural size. A little of the bone at both extremities of this dentary is missing. The portion remaining is 24 mm. long. The triturating surface is hardly

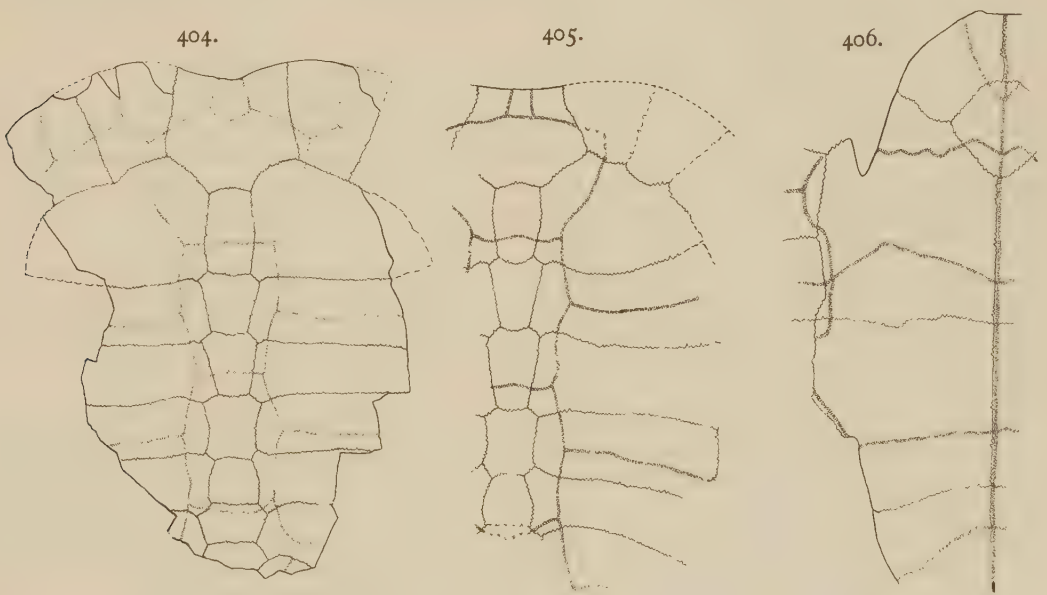
3 mm. wide, and it is transversely concave. In the figure this surface is shaded by horizontal lines. The height of the bone is 7 mm. and the thickness nowhere exceeds 3.5 mm.

The right humerus of No. 5968 is preserved. The head is not globular, but consists of a broad ridge, whose axis makes a small angle with the shaft of the bone, and a groove on the radial side. The whole structure is exactly like that of the humerus of the species of *Trachemys*.

No. 6010 was collected on Little Dry Creek, Wyoming, and therefore belongs to horizon B. It is represented by only the plastron. Fig. 400 shows the upper side of the anterior lobe and fig. 401 the beveled surface of the hinder lobe. Both in front and behind, the beveled horn-covered surfaces are wider than in No. 5988. These figures represent the condition found in a certain number of specimens that must be referred to this species.

Figs. 402 and 403 represent a remarkable specimen which belongs to the Yale University Museum. It was collected by one of Professor Marsh's parties in 1874, in the Bridger Eocene, near Millersville, Wyoming. It was described in the American Journal of Science by Hay, as cited above. It is interesting because of the presence of one extra neural, two extra pairs of costal plates, one extra pair of peripherals, an extra vertebral scute, an extra pair of costal scutes, and an extra pair of marginal scutes. These supernumerary structures are not regarded as of even specific value. It is to be observed, however, that the anterior lobe of the plastron narrows more rapidly than usual and that the base of the hinder lobe is wider than usual; is, indeed, more than half the length of the plastron.

Two specimens in Princeton University are referred to *E. wyomingensis*. These are numbered 10071 and 10072. In both of these the axillary and the inguinal buttresses extend inward but little beyond the free borders of the bases of the plastral lobes. In this respect these specimens differ greatly from those of *E. haydeni*, to which they might easily be referred. Like the latter species, No. 10071 has the fourth neural octagonal, while No. 10072 has this neural heptagonal.



FIGS. 404–406.—*Echmatemys haydeni*. Carapace and plastron. $\times\frac{1}{4}$.

404. Portion of carapace of type. U. S. N. M. 405. Portion of carapace. No. 1067 A. M. N. H.
406. Plastron. No. 1067 A. M. N. H.

Echmatemys haydeni (Leidy).

Plate 47, fig. 2; text-figs. 404–410.

Emys haydeni, LEIDY, Proc. Acad. Nat. Sci. Phila. 1870, p. 123; Ann. Report U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 366.—COPE, Vert. Tert. Form. West, 1884, p. 137.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

Emys wyomingensis, LEIDY, Ann. Report U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 367 (in part); Contrib. Ext. Fauna West. Terrs., 1873, p. 145 (in part), plate ix, fig. 6.

Dr. Leidy's type of the present species was found near Fort Bridger, Wyoming, and probably in the level now known as B. It belongs to the U. S. National Museum and has the number 109. It consists of the anterior part of the carapace. This was figured by Leidy, but the peripherals were omitted, having been found afterwards. These have been included in fig. 404.

Neural.	Length.	Width.
1	50	30
2	32	31
3	34	29
4	33	27
5	26	27
6	23	37

From the front of the nuchal to the anterior border of the seventh neural is 255 mm. The length of the nuchal is 57 mm.; the width in front, 60 mm.; the greatest width, 75 mm. The fourth neural is octagonal. The table shows the dimensions of the neurals.

The first peripheral measures 50 mm. along the free border. The height is 48 mm. The sulcus between the costal and the marginal scutes runs about 20 mm. below the upper border. The dimensions of the vertebral scutes are given in the table below.

No. 1067 of the American Museum was found by Cope in the Bridger region. Fig. 405 shows the carapace; fig. 407, the plastron seen from below; while plate 47, fig. 2, shows the plastron from above. This figure is to be compared with fig. 1 of the same plate, *E. wyomingensis*, especially as to the origins of the axillary and inguinal buttresses.

Vertebral.	Length.	Width.	
		In front.	Greatest.
1	73	87	87
2	70	49	54
3	80	37	53
4	..	50	65

In the American Museum is found the specimen described by Cope as belonging to this species. Its number is 1072. It resembles the specimen to be described below, except that the rib-heads are broader, having the diameter of 12 mm. where they leave the carapace. The individual was slightly larger than No. 1067, but not enough larger to account for the difference.

No. 1071 of the American Museum is a part of the Cope collection, but the exact locality where it was found is not known. It came, however, from the Fort Bridger region. It belonged to an individual whose shell was about 250 mm. long. The bones and sutures have an appearance of immaturity. The features that characterize the specimens already mentioned hold good here. The form was convex, as described by Cope. The fourth neural is octagonal, the fifth quadrate. The vertebral scutes are proportionally wider than in the type, but this may be due to less advanct age. Over the bridge the costo-marginal sulci ran very close to the costo-peripheral sutures. On the costals are seen concentric grooves, which show the growth of the horny scutes. On the first costal bone these are at an average distance apart of 7 mm., a fact indicating rather rapid growth. The plastron is not greatly thickened, the front of the hypoplastron being 11 mm. The lip has a notch in front, which cuts off a tooth on each side. Behind this tooth the thickness is 11 mm.

Another specimen in the American Museum of Natural History which is referred to *E. haydeni* is numbered 3943. It consists of a shell lacking only some of the hinder peripherals. It was collected in 1904, by Mr. Walter Granger, in the Bridger Eocene beds, about the middle of the length of Cottonwood Creek, and therefore belongs to the lower portion of horizon B. The shell is crusht laterally, so that the height is probably greater than in life, being now 182 mm. The length of the plastron is 370 mm., from which it is estimated that the carapace had originally a length of more than 400 mm. The present width is 262 mm.

Neural.	Length.	Width.
1	54	35
2	43	41
3	46	26
4	46	31
5	41	37
6	29	34
7	22	39
8	25	34

The carapace (fig. 407) is smooth and the sulci are moderately imprest. On the last neural and the suprapygals there is a trace of a low keel. The nuchal bone has a length of 69 mm., a width of 56 mm. in front, and a maximum width of about 80 mm. The neurals are broad. Two of these are octagonal, the second and the fourth, but this is believed to be only an individual variation. In the American Museum of Natural History there is a specimen of *Chelydra serpentina* in which the same neurals are octagonal. The table herewith presents the dimensions of the neurals of 3943.

The first suprapygal has a length of 34 mm. and a width of 29 mm. The second suprapygal is 38 mm. long and about 78 mm. wide.

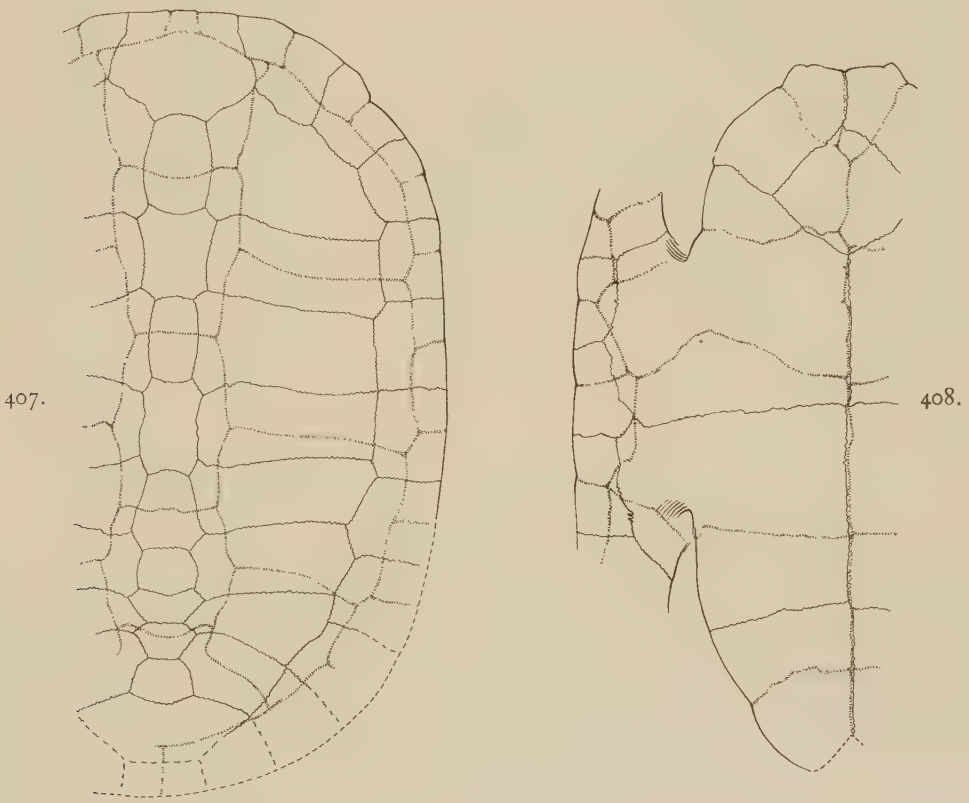
The dimensions of the peripherals appear in the following table.

Dimensions of peripherals.				Dimensions of vertebral scutes.				Dimensions of marginal scutes.			
No.	Height.	Width of free border.	Width of upper border.	No.	Length.	Width of front.	Greatest width.	No.	Height of front.	Greatest height.	Length of free border.
1	49	53	34	1	88	85±	85±	1	20	27	49
2	49	50	31	2	82	59	66	2	25	30	49
3	50	47	28	3	91	43	60	3	23	24	49
6	62	48	46	4	77	52	..	4	26	29	45
8	..	..	42					7	30	40	51

The free border of the nuchal and that of the first pair of peripherals are acute.

The vertebral scutes are long and narrow. The dimensions of these and the marginal scutes are given in the tables above.

As stated already, the plastron (fig. 408) has a length of 370 mm. The anterior lobe is 102 mm. long and 163 mm. wide. The length is therefore about 63 per cent. of the width. The



407. 408.

FIGS. 407 AND 408.—*Echmatemys haydeni*. Carapace and plastron. ×¼. No. 3943 A. M. N. H.

407. Carapace. 408. Plastron.

free border is acute on the hyoplastrals, but becomes thickened and subacute and finally rounded near the lip. The latter is 63 mm. wide. This has the appearance of having been cut off square in front, with a short, blunt tooth on each side. On the upper side (fig. 409), from the acute free border of the lip, the bone thickens backward a distance of 25 mm., where the thickness is 14 mm. The width of the horn-covered surface at the union of the epiplastral and hyoplastral bones is 22 mm. The entoplastron has a length of 66 mm. and a width of 75 mm. The bridge is 148 mm. wide.

The hinder lobe is 11 mm. long and 160 mm. wide, the length being thus 70 per cent. of the width. There is a posterior notch of considerable size. The beveled surface on the upper side of the lobe, at the hypoxiphiplastral suture, is 29 mm. wide.

The gular scutes differ in size. That on the left is 48 mm. long. The humerals are 42 mm. long; the pectorals, 72 mm.; the abdominals, 84 mm.; the femorals, 69 mm.; the anals, 55 mm., measured to the end of the plastron. The axillary scutes are large, but they do not reach backward to the fifth marginals. The inguinals are large and extend forward so as just to touch the sixth marginals.

The inguinal buttresses extend far inward reaching at least half-way from the free border of the base of the hinder lobe to the midline.

No. 6088 of the American Museum is referred to *E. haydeni*. It was found at Henry Fork Hill, 100 feet below the white stratum, in horizon C. The carapace had a length of about 400 mm. For a view of the upper side of the border of the hinder lobe see fig. 410.

E. haydeni is to be distinguisht from *E. wyomingensis* by the axillary and inguinal buttresses. In the latter species the inguinal buttresses extend inward not more than one-third the distance from the free border of the hinder lobe to the midline; while in *E. haydeni* they extend

FIGS. 409 AND 410.—*Echmatemys haydeni*. Portions of lobes of plastron. ×½.

409. Upper surface of anterior lobe. No. 3943 A. M. N. H.
410. Upper surface of free border of hinder lobe of plastron. No. 6088 A. M. N. H.

inward at least half-way to the midline. Usually, if not always, the fourth neural of *E. haydeni* is octagonal, but occasionally this is true of the same neural of *E. wyomingensis*. Usually the upper side of the epiplastral lip of *E. wyomingensis* is short, the thickening not extending backward so far as in *E. haydeni*.

E. shaughnessiana is to be distinguisht by the relatively wider vertebral scutes and the thickened and obtuse free borders of the front of the carapace.

Echmatemys stevensoniana (Leidy).

Plate 48, figs. 1, 2; text-figs. 411–413.

Emys stevensonianus, LEIDY, Proc. Acad. Nat. Sci. Phila. 1870, p. 5.
Emys stevensoni, LEIDY, Ann. Report U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 366.
Emys wyomingensis, LEIDY, Ann. Report U. S. Geol. Surv. Montana, etc., 1871 (1872), p. 367 (in part); Contrib. Ext. Fauna West. Terrs., 1873, p. 141, plate ix figs. 2–4.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448 (in part).

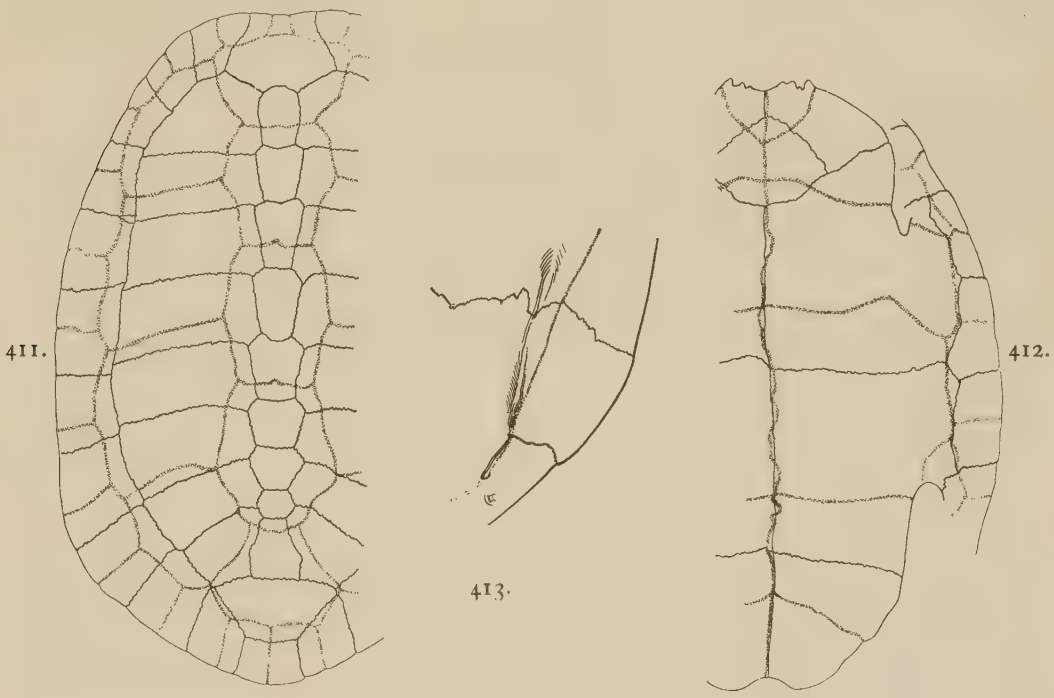
Dr. Leidy's type of the present species was collected somewhere in the vicinity of Fort Bridger, Wyoming, and therefore probably in the lower portion of the Bridger Eocene. His specimen consisted of a portion of a carapace showing the whole series of neurals and the

proximal ends of several costals and a portion of the plastron. It is not certain that the two portions of the shell belonged to the same individual, but it is probable that they did. These bones are figured as cited in the synonymy. With them were figured and referred to the same species a left epiplastron of another individual. This bone was barely mentioned in the original description.

The type is in the U. S. National Museum. The piece of carapace bears the number 965; the piece of plastron, the number 963. The original of Leidy's fig. 4 of the plate cited bears the number 976.

Later Dr. Leidy referred all these bones to his *Emys wyomingensis*. It is the present writer's opinion that the two forms are not identical: but the fragment of plastron represented by Leidy's fig. 4 probably belongs to *E. wyomingensis*.

It is to be remarkt concerning the plastron described by Leidy that the free border of the anterior lobe, from the humero-pectoral sulcus forward to the gulo-humeral, is broken away, so



FIGS. 411–413.—*Echmatemys stevensoniana*. Carapace and plastron. No. 6084 A. M. N. H.

411. Carapace. ×¼. 412. Plastron. ×¼.
413. Upper surface of free border of hinder lobe of plastron. ×½.

that the edge does not extend out as far as it naturally did. The edge of his drawing ought to extend out about 1½ mm. further than it does. Attention may be called to the form and dimensions of the vertebral scutes of Leidy's type, as they are represented in his figure.

In the American Museum of Natural History is a specimen which is referred to this species. It is a nearly complete shell, lacking only the right epiplastron. This shell was collected in the Bridger beds of southwestern Wyoming by the museum's party in the year 1893. No further details are recorded regarding the locality and the level. The matrix filling the shell is a coarse sand in which are inclosed nodules of a greenish clay. The catalog number is 6084.

The total length of the carapace, in a straight line, is 355 mm.; the greatest width 240 mm.; the greatest elevation 125 mm., but this in life was greater. The plastron is convex, an indication that the individual was a female.

In outline the carapace (plate 48, fig. 1; text-fig. 411) is a rather narrow oval, contracted in front of the fore legs. It is slightly excavated above the neck and the hinder end is rather pointed. Posteriorly the peripherals flare slightly upward. The free borders of the nuchal,

the front pair of peripherals, and the hinder peripherals are acute. The borders of the carapace are nowhere notcht. The surface is smooth or relieved only by longitudinal striations.

Element.	Length.	Width.
Neural 1	36	21
Neural 2	32	25
Neural 3	34	24.5
Neural 4	35	24.5
Neural 5	29	27
Neural 6	23	27
Neural 7	22	28
Neural 8	16	18.5
Suprapygal 1	33	25
Suprapygal 2	38	63
Pygal	27	28

The nuchal bone is 53 mm. long, 34 mm. wide in front, and 60 mm. where widest, the table presenting the dimensions of the remaining median bones.

The table below presents the dimensions of some of the peripherals and of the vertebral and marginal scutes. The third peripheral has a height equal to 56 per cent. of the height of the first costal, from the neural to the peripheral.

The vertebral scutes are relatively narrow and the sides of the second and third are moderately bracket-shaped. The interior and posterior are expanded.

The nuchal scute is 10 mm. wide posteriorly and its length is 19 mm. The costo-marginal sulci run well below the costo-peripheral suture. The dimensions of five of the marginal scutes are given in the table below, on the right.

The total length of the plastron (plate 48, fig. 2; text-fig. 412) is 317 mm. The anterior lobe is 88 mm. long and 126 mm. wide at the base, the length being thus 70 per cent. of the width. The lateral borders run directly forward to the hyoepiplastral suture, then curve to the lip. This had a width of 56 mm. and had a tooth on each side. The lip does not extend

Dimensions of peripherals.				Dimensions of vertebral scutes.				Dimensions of marginals.			
No.	Height.	Width of free border.	Width of upper border.	No.	Length.	Width in front.	Greatest width.	No.	Height in front.	Greatest height.	Length of free border.
1	39	38	17	1	58	74	74	1	19	23	31
2	40	38	23	2	67	37	57	2	24	27	35
3	41	48	26	3	68	35	53	3	20	21	40
6	48	48	46	4	78	37	58	4	21	27	44
8	53	42	31	5	50	24	67	9	38	43	42

as far forward as the nuchal bone. The thickening on the upper side of the symphysis of the epiplastrals extended backward 25 mm. The greatest thickness of the epiplastrals is 13 mm., and between these thickenings the bones are slightly channeled longitudinally. The thickness of the symphysis is 13 mm. The horn-covered surface of the upper side of the epiplastron, at the suture with the hyoplastron, is 18 mm. wide. The entoplastron is 47 mm. long and 57 mm. wide. It is pointed in front; rounded behind.

The bridge has a width of 136 mm.

The hinder lobe is 105 mm. long, and 140 mm. wide at the base. The length is therefore 75 per cent. of the width. The buttresses arise far within the free border of this lobe. The beveled surface of the upper lobe (fig. 413), at the suture with the xiphiplastrals, is 28 mm. wide. The free borders of the lobe are acute. The posterior notch is about 28 mm. wide and 6 mm. deep. The posterior buttresses appear to have extended at their bases about half-way to the midline. How high they rise has not been determined.

The gulars are 45 mm. long; the humerals, 20 mm.; the pectorals, 63 mm.; the abdominals, 91 mm.; the femorals, 52 mm.; and the anals, 45 mm.

The axillary scute is large, extending outward and backward to form contact with the fifth marginal for a distance of 6 mm. The inguinal scute extends forward within 13 mm. of the sixth marginal.

From *E. naomi* the species differs in having a smoother shell, with less deeply imprest channels for the sulci, and in having narrower neurals. The carapace of *E. stevensoniana* is more contracted in front. *E. shaughnessiana* is set off by the bluntly rounded anterior border of the carapace. From *E. ægle* the present species is distinguisht by the larger axillary scute, the deep grooving of the carapace, the lower position of the costo-marginal sulci, the relatively broader and shorter anterior lobe of the plastron, etc. In *E. ocyrrhoë* the carapace is smooth,

the costal plates are alternately wide and narrower at their opposite ends, the beveled surface of the upper side of the hinder lobe is narrower and the axillary scute is far from reaching the fifth marginal. Other differences are noted under *E. ocyrrhoë*. *E. arethusa* is distinguisht by the contracted epiplastral lip and other characters.

E. stevensoniana is distinguisht from *E. septaria*, which it most resembles, by not having the anterior lobe so much expanded, and by not having the costo-marginal sulcus so near the upper edge of the peripheral bones. The form and the dimensions of the anterior marginal scutes are quite different in the two species; and the pectoro-abdominal sulcus of *E. stevensoniana* does not approach so closely at the midline the hyohypoplastral suture as it does in both the specimens of *E. septaria* in the American Museum.

Echmatemys septaria (Cope).

Text-figs. 414–420.

Emys septaria, Cope, 6th Ann. Report U. S. Geol. Surv. Terrs., 1873, p. 625; Amer. Naturalist, xvi, 1882, p. 992; Vert. Tert. Form. West, 1884, pp. 130, 139, plate xvii, figs. 9–13.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.
Echmatemys septaria, Hay, Bull. Amer. Mus. Nat. Hist., xxii, p. 28, fig. 1.

The type of this species is in the U. S. National Museum and consists of a tolerably complete plastron; a portion of the central region of the carapace, including the third, fourth, and fifth neurals, with portions of the second, third, and fourth left costals; and a fragment showing parts of the fifth, sixth, and seventh right costals and abutting peripherals. This type was collected in the beds of the Washakie basin in the badlands of South Bitter Creek, Wyoming.

All of Professor Cope's illustrations are one-third the natural size, instead of one-fourth. Fig. 12 represents the piece which includes the three neurals mentioned and the corresponding costals, but the sutures bounding these bones are not shown. Moreover, the lower end of the figure is the forward end of the fragment. The fragment illustrated by fig. 13 is not stated to have had any connection with that of fig. 12; but the two pieces join accurately. If fig. 13 is conceived as being swung around so that the end of the suture near its lower right-hand corner shall coincide with the end of the fracture seen in fig. 12, at the bottom of the concave border on the right-hand side, the pieces will be in their natural relation.

The first neural bone is 42 mm. long and 23 mm. wide. The next two neurals, all whose form can be determined, are hexagonal, with the broad end forward. Of these the second is 35 mm. long and 30 mm. wide, while the third is 40 mm. long and 27 mm. wide. The peripherals are high, the fourth and fifth rising above the edge of the shell about 42 mm. The nuchal and the peripherals abutting on it have sharp free borders. The nuchal is 50 mm. long and 67 mm. wide.

The first vertebral scute is 67 mm. long and 80 mm. wide; the second 78 mm. long and 66 mm. wide at the point of the brackets. The nuchal scute is narrow, about 20 mm. All the epidermal sulci are rather deeply imprest, but are not broad.

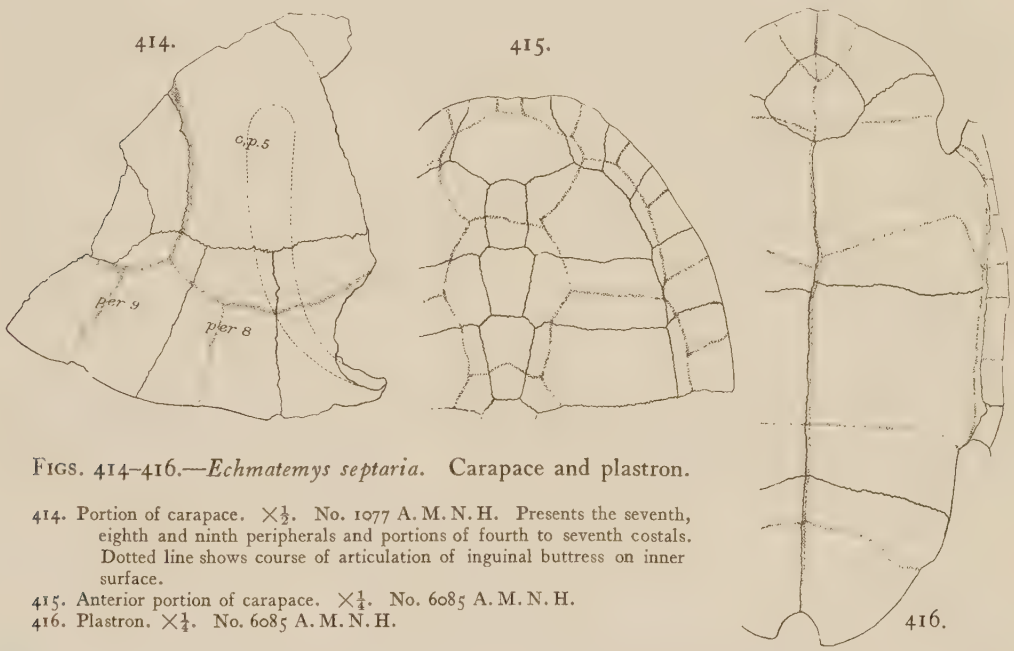
The inguinal buttresses extend well up into the carapace. They reach inward about 40 mm. from the inner surface of the fifth costal plate. They are very thin in comparison with those of *E. shaughnessiana*. Cope states (Ann. Rep. Hayden Surv. for 1872, p. 625) that this buttress is connected with both the fifth and sixth costal plates. An examination of his type shows that on the left side the union is almost entirely with the fifth costal, while the sixth only just comes into contact with the buttress. On the right side the sixth takes more part in the articulation. The position of this buttress probably varies somewhat in different individuals of this species. In No. 6085, American Museum of Natural History, described below, it comes into contact with the sixth costal. In No. 1077, American Museum of Natural History, the buttress rests on the middle of the fifth costal (fig. 414), and is hence far from the border of the sixth; but this specimen appears to be abnormal in some other respects. There are considerable differences between Cope's type and No. 1077 in the structure of the costals and peripherals in the region of the inguinal notch. There is no considerable difference in the widths of the costals, and the peripherals coincide pretty closely with the ends of the costals. In No. 1077, American Museum of Natural History, the arrangement is as shown in fig. 414. This figure shows parts of the fourth, fifth, sixth, and seventh costals and the seventh, eighth,

and ninth peripherals. The dotted line shows the position of the inguinal buttress on the inner side of the shell.

In the American Museum of Natural History there are various specimens which enable us to add much to our knowledge of the structure of this species. Unfortunately, none of the specimens is complete; and even when all are taken together, we are left in ignorance of much of that part of the carapace behind the inguinal notch.

Among the materials referred to are some which were collected by Professor Cope in 1872, but which do not appear to have been identified by him. One of these, No. 1077, furnishes the greater portion of the anterior lobe of the plastron; the hinder lobe, except the hinder ends of the xiphiplastrals; and a piece (fig. 414) of the carapace consisting of parts of fourth, fifth, sixth, and seventh costals and the sixth, seventh, and eighth peripherals. The remains of another individual, No. 1076, somewhat larger than the type, present the second and third peripherals of both sides, many fragments of costals, nearly the whole of both epiplastra, and a portion of both xiphiplastrals. A third specimen, No. 1079, from Haystack Mountain, Wyoming, consists of the epiplastra of a still larger individual.

The best example of this species in the American Museum is numbered 6085, and was collected in the Bridger beds of Wyoming, by the expedition sent out in 1893. The exact locality and level are not on record. This individual lacks the whole of the carapace behind the



FIGS. 414–416.—*Echmatemys septaria.* Carapace and plastron.

414. Portion of carapace. ×½. No. 1077 A. M. N. H. Presents the seventh, eighth and ninth peripherals and portions of fourth to seventh costals. Dotted line shows course of articulation of inguinal buttress on inner surface.
415. Anterior portion of carapace. ×¼. No. 6085 A. M. N. H.
416. Plastron. ×¼. No. 6085 A. M. N. H.

inguinal notch; neurals and costals immediately in front of this notch are crusht and damaged, but the remainder of the carapace and the whole of the plastron are in fine condition. It is accompanied by another chelonite, No. 6089, which presents the anterior two-thirds of both carapace and plastron in fine condition. Unless otherwise stated the following description is derived from No. 6085.

The length of the carapace (fig. 415) can not be determined with exactness; but it was close to 380 mm. The breadth was at least 210 mm. The elevation of the shell in life can not now be determined. It is now 141 mm. high. The indications furnisht by the various specimens are that the shell was quite convex. The plastron is nearly flat in the middle portion; but the anterior lobe rises in front; and the hinder lobe is somewhat concave, especially near the borders.

At the sides the carapace rises from the plastron upward and outward about 57 mm., then turns steeply upward, and curves toward the midline of the back. The lateral carina on the bridge peripherals is obtuse. There is no dorsal carina; nor is the carapace especially flared upward at the sides in front.

The neural bones are of moderate width; the table shows their dimensions: The length of the nuchal was close to 56 mm.; its width along the free border about 42 mm.; its greatest width is 67 mm. The free border of the nuchal and those of the first peripherals

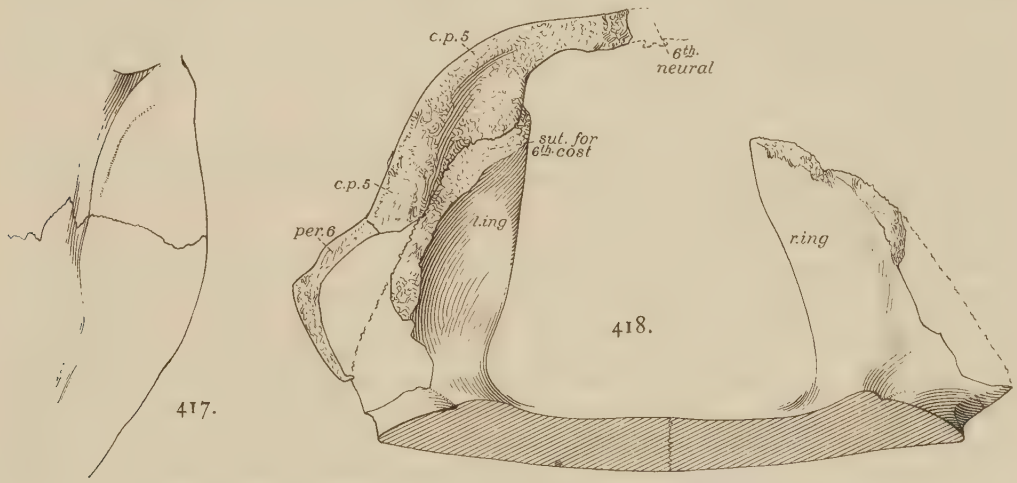
Dimensions of neurals.			Dimensions of peripherals.			
No.	Length.	Width.	No.	Height.	Width of free border.	Width of costal border.
1	42	22	1	44	37	17
2	34	28	2	40	36	23
3	40	27	3	45	43	30
			5	45	45	45

are acute, especially as shown by No. 6089; but the bone thickens rapidly toward the costals. The thickness of the first and second peripherals at their articulation is 20 mm.

The dimensions of the peripherals are shown in the table above.

Scute.	Vertebral.			Marginal.		
	Length.	Width.		Height.		Length of free border.
		In front.	Greatest.	In front.	Greatest.	
1	65	79	79	15	26	32
2	76	38	65	26	35	37
3	75±	38	60±	30	30	39

The upper surface of the carapace is nearly smooth, but is relieved by striation and faint lines of growth; but these are not so distinct as they are on Cope's type of *E. septaria*. The second and third vertebral scutes are urn-shaped, expanded in front, and narrowed behind. The first vertebral is the broadest. The dimensions of vertebral and marginal scutes are given in the second table above.



FIGS. 417 AND 418.—*Echmatemys septaria*. ×½. No. 6085 A. M. N. H.

417. Upper surface of free border of hinder lobe of plastron.
418. Section across shell at the inguinal buttresses. Shows the sixth peripheral (*per.* 6), the fifth costal plate (*c. p.* 5), and the right and left inguinal buttresses (*r. ing.*, *l. ing*).

It will be observed that the second marginal is unusually high. This is true in both No. 6085 and No. 6089. As shown by both these specimens, the costo-marginal sulci run near the costo-peripheral sutures; in No. 6085, a few millimeters below; in No. 6089, on the sutures.

The plastron (fig. 416) has a total length of 345 mm. The anterior lobe is 95 mm. long and 133 mm. wide at the base, the length thus being 71 per cent. of the width. The entoplastron is 50 mm. long and 53 mm. wide. Immediately in front of the axillary notch the lobe narrows a

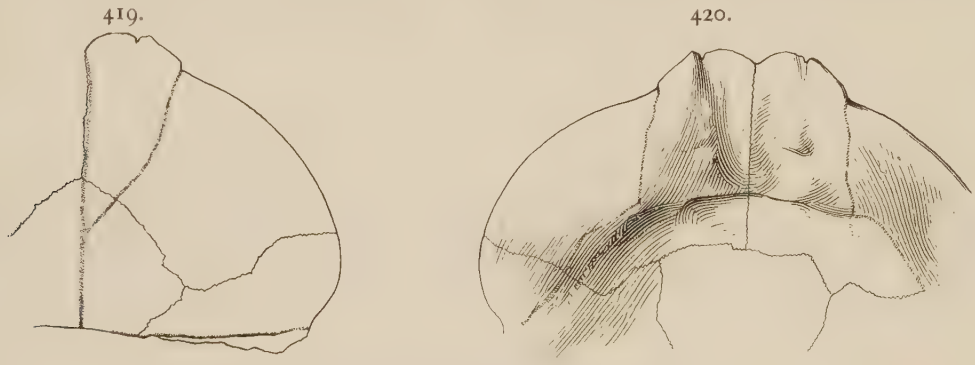
few millimeters, then begins to expand and becomes wider than at the base. At the hyoepiplastral suture the lobe narrows again and passes rapidly to the lip. This is relatively narrow, 47 mm., is notcht at the midline, and is furnisht on each side with a blunt tooth. The epiplastrals thicken toward the lip and become 20 mm. thick. For some distance on each side of the symphysis of the bones the thickness is reduced to 15 mm. The lateral expansion of the anterior lobe and the lip form the most distinctive characters of this species.

The bridge has a width of about 138 mm.

The hinder lobe is 114 mm. long and 156 mm. wide. It is notcht behind, as in the other species of the genus. The beveled surfaces (fig. 417) on the upper side of this lobe are 33 mm. wide at the hypoxiphiplastral sutures. The posterior buttresses (fig. 418) are wide, beginning to rise from the floor of the plastron at a line nearer to the midline than to the free border of the lobe. They are articulated to the fifth and sixth costals and rise to a height of 65 mm. above the floor of the plastron.

The gulars have a length of 54 mm.; the humerals, 31 mm.; the pectorals, 68 mm.; the abdominals, 83 mm.; the femorals, 51 mm.; the anals, 49 mm., at the midline. The axillary scute has not reacht the fifth marginal, nor the inguinal the sixth.

As in other species of this genus the posterior buttresses articulate with the fifth and sixth costals. Fig. 419 represents the anterior lobe of the plastron of No. 1077, American



FIGS. 419 AND 420.—*Echmatemys septaria.* Anterior lobe of plastron. ×½. No. 1077 A. M. N. H.
419. Lower surface. 420. Upper surface.

Museum of Natural History. It will be observed how this expands in front of the base. Fig. 420 presents a view of the same bone seen from above. The width of the lip is indicated, also the backward extension of the thickening of the epiplastrals.

No. 10303 of the collection at Princeton University is to be referred to this species. It lacks only a small portion of the rear of the carapace and the tips of the xiphiplastra. It was collected in 1878, at Twin Buttes, Wyoming, in the Bridger beds, belonging to level C or D. The carapace was close to 335 mm. long. The interior of the shell is cleaned out, so that all parts are exposed. The sides of the anterior lobe are hatchet-shaped, as is peculiar to the species. The horn-covered areas on the upper side of the hinder lobe are 39 mm. wide.

Vertebral.	Length.	Width.	
		Anteriorly.	Greatest.
1	64	..	87
2	74	45	77
3	78	39	76
4	..	47	83

The vertebral scutes are narrow at the ends, wide in the middle, the measurements being given in the accompanying table.

These scutes are much wider in proportion to their length than in Cope's type and other specimens studied. The sulci are broad and deeply imprest. It is possible that the specimen belongs elsewhere. Nos. 10073 and 10304 of the Princeton collection are likewise referred to *E. septaria.*

In the Philadelphia Academy collection is the specimen which Leidy described as *Emys wyomingensis* (Contrib., etc., pp. 148, 152, 153, No. 14). It is regarded by the present writer as belonging to *E. septaria.* The sulci are deeply sunken and the surface of the carapace is corrugated. The axillary and the inguinal scutes are well developt.

It is unfortunate that so many of the specimens which must be referred to this species are devoid of exact records regarding their levels and localities.

Echmatemys arethusa sp. nov.

Plate 49, figs. 1, 2; text-figs. 421, 422.

The present species is founded on a single specimen which was collected by the American Museum expedition of 1903 into the Badlands in the vicinity of Bridger, Wyoming. The locality in which it was obtained is the western portion of Grizzly Buttes and the level the lower portion of horizon B. The catalog number of the specimen is 5920.

The specimen lacks most of the left peripherals, all of those behind the ninth, and most of the xiphiplastrals. It has likewise been crusht toward the left side.

The length of the plastron to the front of the xiphiplastrals is 225 mm., from which we estimate that the whole length of the plastron has been close to 292 mm. and the length of the carapace, 328 mm.

With the exception of faint longitudinal striations, the surface of the carapace (plate 49, fig. 1) is smooth. The fourth vertebral scute is traversed by a low rounded keel.

Neural.	Length.	Width.
1	42	25
2	33	29
3	35	28
4	30	27
5	30	30
6	21	36
7	17	33
8	21	30

The nuchal and first neural have been fractured so that their exact dimensions can not be determined; but the free border of the nuchal was close to 48 mm. and the length was close to 50 mm. The neurals furnish the measurements shown in the table.

The free border of the nuchal and first pair of peripherals is acute. The sulci of the carapace are narrow and not deeply imprest. The vertebral scutes are narrow and the sides of the second, third, and fourth are nearly parallel. The table below presents the dimensions of some of the peripherals, and of some of the vertebral and marginal scutes, so far as determinable. It will be noted that the fifth vertebral is unusually wide.

The nuchal scute has a width posteriorly of 9 mm. Its length can not be determined. The costo-marginal sulci run a moderate distance below the costo-peripheral sutures.

As already stated, much of the plastron (plate 49, fig. 2; text-fig. 421) is missing. The length of the anterior lobe is 78 mm.; the width of its base is 144 mm. The length is therefore

Dimensions of peripherals.				Dimensions of vertebrals.				Dimensions of marginal scutes.			
No.	Height.	Width of free border.	Width of upper border.	No.	Length.	Width in front.	Greatest width.	No.	Height in front.	Greatest height.	Length of free border.
1	41	42	26	1	64	68	68	1	17±	28	35±
2	39	43	27	2	66	40	53	2	25	25	39
3	43	43	26	3	65	40	53	3	22	27	43
6	44	43	36	4	60	50	64	4	27	35	40
8	50	38	31	5	..	42	105±	9	39	42	40±

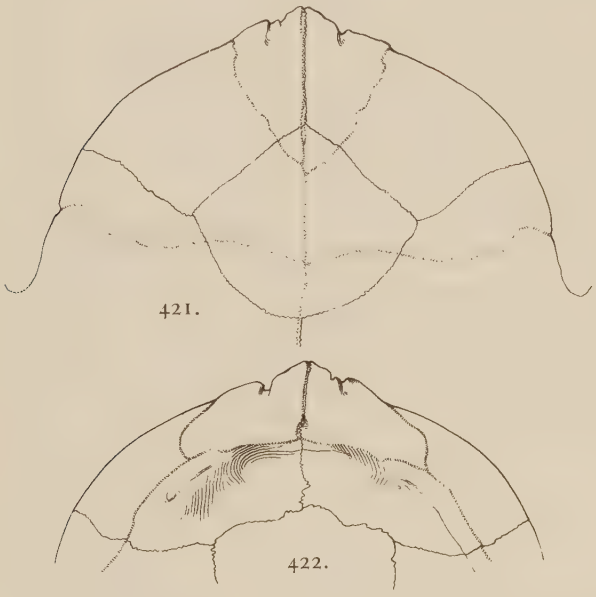
only 54 per cent. of the width. From the axillary notches its free borders curve regularly to the epiplastral lip. This is narrow, 40 mm.; large lateral tooth just within each gular sulcus. There is a projecting tooth in the midline and on each side of it a minute tooth. On the upper side of the epiplastrals (fig. 422) the gular scutes expand until they have a width of 65 mm. The thickening of the epiplastrals on the upper side extends backward from the tip of the median tooth 23 mm. The greatest thickness of the epiplastrals is 13 mm. Just outside of the gular sulci, on the upper side, the horn-covered surface is 12 mm. wide; at the suture with the hyoplastrals, 14 mm. The entoplastron has a length of 50 mm. and a width of 58 mm. The thickness of the plastron at the crossing of the median suture and that between the hyoplastrals and hypoplastrals is 15 mm.

The width of the bridge is 116 mm.

The length of the hinder lobe can not be determined. Its width at the base has been 146 mm. The inguinal buttresses arise about half-way from the border of the hinder lobe to the midline.

The gular scutes are 41 mm. long; the humerals, 25 mm.; the pectorals, 55 mm.; the abdominals, 70 mm.; and the femorals, 47 mm.

The axillary scute extends backward in a long point to come into bare contact with the fifth marginal. The inguinal scute extends forward and joins narrowly the sixth marginal.



FIGS. 421 AND 422.—*Echmatemys arethusa*. Anterior lobe of plastron. $\times\frac{1}{2}$. No. 5920 A. M. N. H.

421. Lower surface. 422. Upper surface.

This species differs from *E. naomi* in the form of the vertebral scutes, in the lack of grooves for the sulci of the carapace, in the very different form of the front of the anterior lobe, and in the axillary and inguinal scutes. The broad neurals, the very broad fifth vertebral scute, and the plastral lip differentiate it from *E. stevensoniana*. The acute anterior border of the carapace, the plastral lip, and the advanct position of the humero-pectoral sulcus separate it from *E. shaughnessiana*. The very different plastral lip, among other characters, removes it from *E. septaria*. *E. ocyrrhoë* has the costal plates differentiated so that the ends are alternately wider and narrower; the epiplastral lip is different from that of *E. arethusa;* as are also the axillary and inguinal scutes. *E. ægle* has the vertebral scutes urn-shaped, the anterior lobe is very different, and the axillary and inguinal scutes fall short respectively of the fifth and sixth marginals. The plastral lip of *E. cyane* is widely different; the axillary scute falls short of the fifth marginal; the inguinal far short of the sixth; the second and third peripherals measure together 64 mm. along the free border, while the same bones in the type of *E. arethusa* measure 85 mm. *E. haydeni*, so far as known, differs in having the fourth neural octagonal, the vertebral scutes narrower, and a very different form of epiplastral lip.

Echmatemys cyane sp. nov.

Figs. 423–427.

No. 5924 of the American Museum of Natural History is a fragmentary specimen presenting most of the left side of the carapace, including four neurals, most of the left side of the plastron, and a part of the right side. The specimen was secured by the expedition in 1903, into the Bridger Eocene, at Grizzly Buttes, Wyoming. Its horizon is therefore that called B.

The length of the carapace (fig. 423) of this individual can not be exactly determined. From the front of the nuchal to the hinder end of the sixth neural is 246 mm., from which fact it is estimated that the carapace had a length of 340 mm. Like most of the Bridger species of the genus, this species had a thick shell. The surface of the carapace is mostly smooth.

Neural.	Length.	Width.
2	33	28
3	35	28
4	33·5	30
5	29	30
6	22	30

Of the nuchal only a portion of the left side is present, but this shows that its width in front was very close to 50 mm. The greatest thickness is 15 mm. The first neural is not present. Those preserved show the dimensions given in the table herewith. These neurals have a thickness of 12 mm. The costals have the two ends of each about the same width. The width of the first costal equals 77 per cent. of its height.

The dimensions of some peripherals and of some vertebral and marginal scutes are given in the table on the following page. The third peripheral is half as high as the first costal.

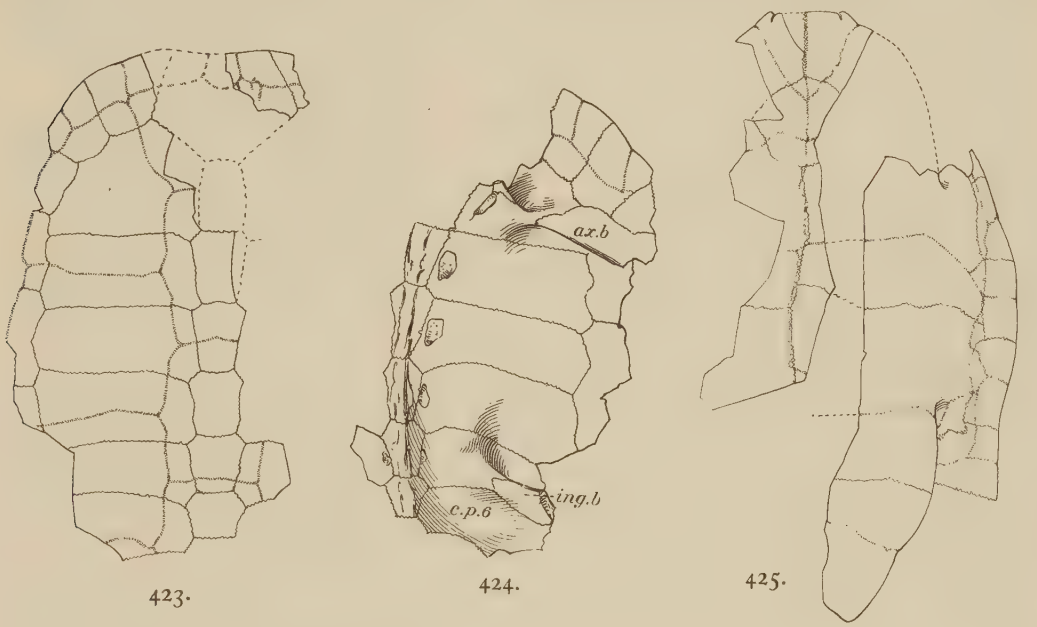
The seventh peripheral has at its hinder sutural border a thickness of 13 mm. A rather prominent rounded keel runs along on the peripherals over the bridge.

The broadest vertebral scute is the first. The second and third are of moderate width, with the sides somewhat bracket-shaped.

Dimensions of peripherals.				Dimensions of vertebral scutes.				Dimensions of marginal scutes.			
No.	Height.	Width of free border.	Width of costal border.	No.	Length.	Width in front.	Greatest width.	No.	Height in front.	Greatest height.	Length of free border.
1	39	32	24	1	52	96±	96±	1	13	19	..
2	40	34±	20	2	80	52±	60±	2	20	24	37
3	41	36	22	3	73	40	60	4	23	..	40
6	47	43	44	4	..	47	60	7	27	27	42
7	48	39	30								

The costo-marginal sulci run at a distance of about 20 mm. below the costo-peripheral sutures. On the under side of the nuchal and the first and second peripherals the marginal scutes are 28 mm. wide.

On the visceral side of that portion of the carapace present (fig. 424) are exhibited the axillary and the inguinal buttresses and the shoulders of bone against which they abut. The



423. 424. 425.

FIGS. 423–425.—*Echmatemys cyane*. Carapace and plastron of type. ×¼.

423. Portion of carapace.
424. Portion of carapace, inner surface. *ax. b.*, axillary buttress; *c. p. 6*, sixth costal plate; *ing. b.*, inguinal buttress. On the left are seen some neurals and the bases of the rib-heads.
425. Two fragments of the plastron.

axillary buttress has a maximum width of 25 mm. and is 12 mm. thick. It ascends within the first costal to a point 25 mm. or more above the upper border of the second peripheral, considerably further than the buttress ascends in *E. wyomingensis*, No. 5987 and No. 5988, A. M. N. H. It abuts against an extremely prominent ridge, 12 mm. thick and 10 mm. elevation above the general surface of the costal. This buttress and ridge are therefore very different from those of the species just mentioned. The distance from the upper end of the buttress to the base of the rib-head is less than the distance from the summit of the buttress to the border of the second peripheral. In *E. wyomingensis* the former distance is much greater than the latter.

The posterior buttress articulates for a moderate distance against the inner surfaces of the fifth and the sixth costals, about as far as in *E. wyomingensis*, but it appears that the but-

tress of the latter did not project so far from the inner surface of the carapace and was thinner. In *E. wyomingensis*, as represented by No. 5987, at a point 20 mm. below its summit, the buttress projects inward from its articulation only 9 mm.; in *E. cyane* it projects inward 23 mm., a difference hardly to be regarded as merely individual.

The plastron (fig. 425) had a length very close to 325 mm. On account of the absence of some fragments which connected parts which are present, the exact length can not be determined. The length of the anterior lobe was very close to 90 mm.; the width was not far from 130 mm. The epiplastral lip has a width of 54 mm. It projects but slightly beyond the general outline of the lobe. It is truncated, with an acute free border. The lateral portion consists of a stout tooth separated from the remainder of the lip by a deep slit. On the upper side the thickening of the epiplastrals (fig. 426) extends backward from the free border a distance of 28 mm. The epiplastrals are nowhere greatly thickened, the maximum being 11 mm. The entoplastron had a length close to 49 mm., and the width has been 56 mm. It is rounded in front and behind.

426.

427.

FIGS. 426 AND 427.—*Echmatemys cyane*. Plastron of type. $\times\frac{1}{2}$.

426. Upper surface of epiplastral lip.
427. Upper surface of left side of hinder lobe.

The bridge has a width of 132 mm. The plastral bones are 21 mm. thick at the crossing of the median longitudinal and the hyohypoplastral sutures.

The hinder lobe has a length of 113 mm. The width appears to have been about 146 mm. The beveled surfaces on the upper side of the lobe (fig. 427) have a width of 28 mm. at the hypoxiphiplastral sutures, of which width 21 mm. were covered with horny scutes. The thickness of the bones at the sutures just mentioned is 12 mm.

The inguinal buttresses send their bases inward from the free borders of the posterior lobe a distance of about 33 mm., almost half the distance to the midline. Thus they extend inward further than in *E. wyomingensis*, but not so far as in some other species of the genus.

The gulars have a length of 57 mm.; the humerals, about 55 mm.; the pectorals, 55 mm.; the abdominals, 90 mm.; the femorals, about 55 mm.; the anals, about 42 mm., all measured at the midline. No part of the axillary scute is seen, but it failed by at least 28 mm. of reaching the fifth marginal. It could have joined the anterior end of the fourth for only about 10 mm. The inguinal scute lacks 10 mm. of reaching forward to the sixth marginal.

It is hardly necessary to compare at length this species with *E. shaughnessiana*, which has a thick epiplastral lip and a thick rounded free border on the nuchal; or with *E. ægle*, with its urn-shaped vertebral scutes; or with *E. arethusa*, with its contracted epiplastral lip; or with *E. naomi*, with its urn-shaped vertebral scutes and sulci lodged in deep grooves.

From *E. wyomingensis* it differs in having the inguinal buttresses reaching inward about half-way to the midline, in having the axillary buttresses ascending nearer the neurals, in having the epiplastrals thickened farther backward on the upper side of the symphysis and in having wider vertebral scutes. *E. ocyrrhoë* differs in having the vertebral scutes, especially the second, considerably wider and in having the marginal scutes of the anterior half of the shell rise higher on the peripherals. The American Museum specimen of *E. stevensoniana* has almost exactly the size of that of the present species, so that comparisons may be readily made. *E. stevensoniana* has narrower neurals and narrower vertebral scutes. The plastron of *E. stevensoniana* appears to be thicker than that of *E. cyane*. Measured behind the abdominofemoral sulcus and one-third the distance from the midline to the free border, plastron of the former is 8.3 mm. thick; of the latter 11 mm. The axillary scutes of *E. stevensoniana* extend backward to the fifth marginal, while in *E. cyane* they fall far short of the latter marginal. In

E. stevensoniana the maximum thickness of the first and second peripherals at their articulation is 14 mm.; in *E. cyane*, 17 mm.

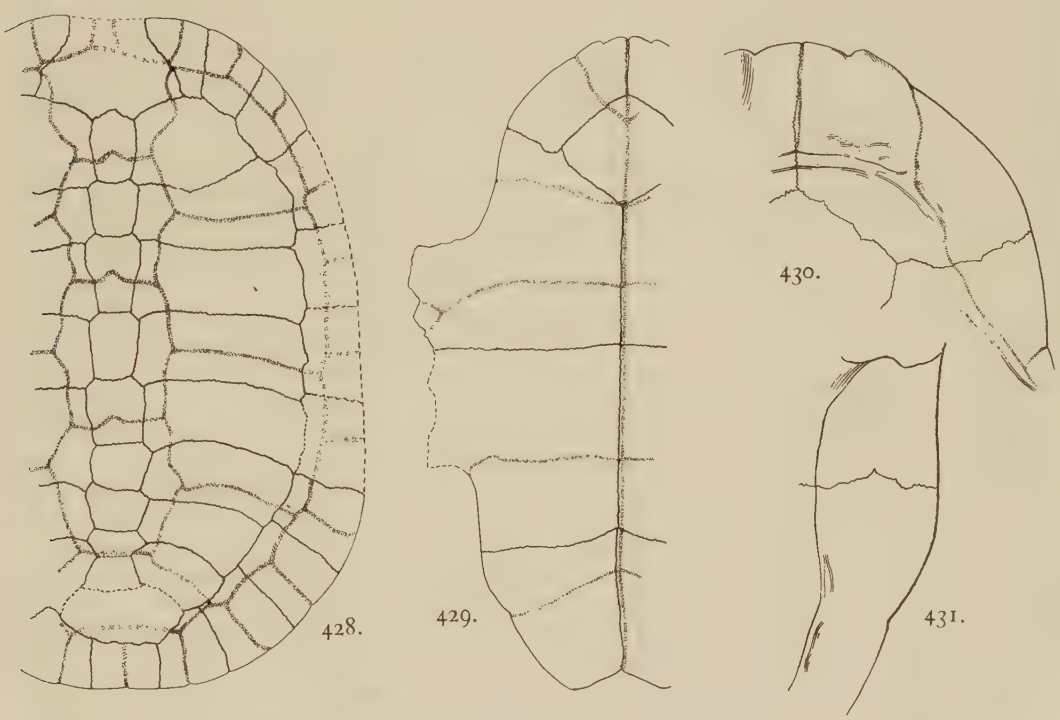
E. cyane differs from *E. haydeni* in the narrower inguinal buttresses, extending in the former hardly half-way from the free border of the hinder lobe to the midline; in *haydeni* more than half-way. In *E. cyane* the thickness of the second neural is 11 mm.; in *haydeni*, 14 mm. The center of the plastron of *E. cyane* is 20.5 mm.; that of *E. haydeni* is 25 mm. Probably, however, it will not do to rely too much on the relative thickness of the neurals and of the plastron. *E. cyane* has wider vertebral scutes than *E. haydeni*, and the fourth neural is not octagonal.

Echmatemys shaughnessiana (Cope).

Plate 50, figs. 1, 2; text-figs. 428–431.

Emys shaughnessiana, Cope, Amer. Naturalist, xvi, 1882, p. 992; Vert. Tert. Form. West, 1884, pp. 130, 135, plate xxiii, figs. 3–8.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

This species was first mentioned in 1882, but the only statement made regarding it by Professor Cope is that its bones are very thick. In 1884 a description was publisht, illustrated by figures of the carapace. No part of the plastron was figured. The specimen was found in



Figs. 428–431.—*Echmatemys shaughnessiana.* Carapace and plastron of type.

428. Carapace. ×¼. Parts restored are shown by interrupted lines.
429. Plastron. ×¼. 430. Upper surface of front lobe of plastron. ×½.
431. Upper surface of border of hinder lobe of plastron. ×½.

the Bridger deposits of Wyoming, in 1872, on Cottonwood Creek, therefore about the middle of stage B.

The type of the species is now in the possession of the Museum of Natural History and bears the number 1069. A further description is here furnisht as well as figures of both carapace and plastron. This is the more to be desired, since some of Professor Cope's measurements are found to be incorrect.

Professor Cope recognized that this species resembles in many respects Dr. Leidy's *E. wyomingensis;* and he has given what he regarded as differential characters. In general,

he regarded the bones of the carapace, especially the neurals, as much thicker than those of the species just mentioned. It is doubtful if this is a correct statement. His statement that the axillary buttresses are thicker than those of *E. wyomingensis* appears to be true. The capitula of the ribs are fully as broad as those of *E. haydeni*, altho apparently not so thick. The peripherals are about as much recurved as those of *E. wyomingensis*.

The following appear to be characters distinguishing this species from *E. wyomingensis:* The axillary buttresses, and apparently also the inguinal, are thicker; the humero-pectoral suture passes behind the entoplastron; the femoral scute extends inward on the upper surface of the hinder lobe of the plastron as far as the inner border of the inguinal buttress; the anterior border of the carapace has a much more obtuse edge; the free border of the epiplastron is thicker and more obtuse; and the smooth band on the upper surface of the hinder lobe is much wider, as is also the thickening on the upper side of the epiplastral lip.

From the type of *E. shaughnessiana* there are missing the nuchal bone, except a fragment; the eighth neural; both suprapygals; all the peripherals over both bridges, except a part of the right fourth; some of the free peripherals of the left side and the seventh of the right side; the distal ends of two left costals; the left half of the plastral lip; and parts of the bridge. The forms of the nuchal, the eighth neural, and the suprapygals and pygal can be quite accurately determined from the surrounding bones, so that from one side or the other of the shell we have the means of determining nearly all the elements.

The total length of the carapace (plate 50, fig. 1; text-fig. 428), in a straight line, is 352 mm. Cope's measurement of 380 mm. includes the curve. The width was approximately 270 mm. Near the midline in front the outline has been gently concave; the posterior margin has been broad and rounded.

The table herewith presents the dimensions of the nuchal, neurals, and suprapygals. The third neural has a thickness of 15 mm.; the third costal at its outer end is 7 mm. thick.

Element.	Length.	Width.
Nuchal.....	52	72
Neural 1.....	40	23
Neural 2.....	28	25
Neural 3.....	38	26
Neural 4.....	32	24
Neural 5.....	32	29
Neural 6.....	21	28
Neural 7.....	32	23
Neural 8.....	20	28
Suprapygal 1..	65	..
Suprapygal 2..		70

The costals show no remarkable peculiarities. The second is only 28 mm. wide at its proximal end; 46 mm. at its distal end and 8 mm. thick near the border of the vertebral scute. The fifth and sixth of the left side are, as an individual peculiarity, co-ossified proximally and measure together only 47 mm.; whereas the corresponding ones of the other side are distinct from each other and measure 59 mm. The peripherals resemble those of *E. wyomingensis*, but the anterior are higher and far less acute. The posterior are acute. However, they are not gradually thinned out, as are those of *E. wyomingensis*, but come rather abruptly to an edge. Cope's figure (Tert. Vert., plate xxiii, fig. 6) represents this condition only moderately well. The first peripheral is 12.5 mm. thick where it joins the nuchal. The second is 45 mm. high; its free border is 37 mm. long. The third is 50 mm. high and 44 mm. along the free border. On these the marginals ascend about 24 mm. above the free border of the bones.

Cope's figure of the carapace represents the seventh right peripheral as present; but it is not now in the collection. The corresponding one of the left side is present.

The width of the first costal bone is 60 per cent. of the length along the hinder border.

The scutes of the carapace are rather broad and their lateral sulci are bracket-shaped. The nuchal is missing. The table below gives the dimensions of the vertebral scutes.

Dimensions of vertebrals.

Scute.	Length.	Width in front.	Greatest width.
Vertebral 1..	55±	68	68
Vertebral 2..	60	37	58
Vertebral 3..	71	39	58
Vertebral 4..	75±	45	65
Vertebral 5..	62±	36	96

The upper borders of the marginal scutes run considerably below the sutures between the costal and peripheral bones. All the scutal sulci are narrow, but sharply imprest.

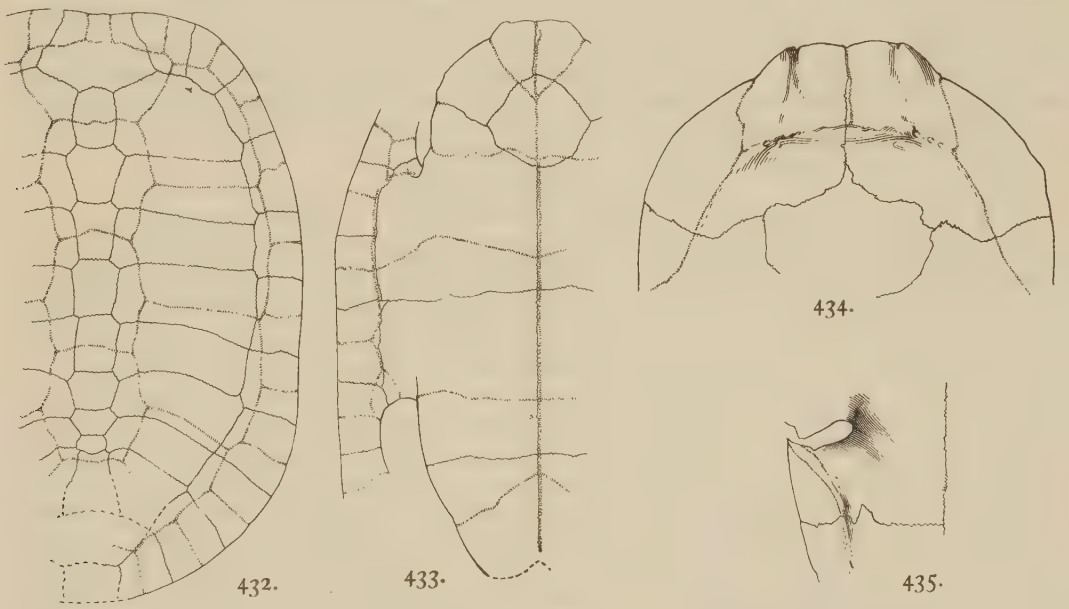
The plastron (plate 50, fig. 2; text-fig. 429) has a total length of 342 mm., falling short of the length of the carapace only 10 mm. In the midline the length is 13 mm. less, on account of the notch. The anterior lobe is 97 mm. long and, at the base, is 144 mm. wide. The lip, as seen from below, and measured from one gular suture to

the other, is 56 mm. wide. A notch in the border produces a blunt tooth on each side. Beyond the notch the general curvature of the lobe is continued on to the midline. It remains to be seen whether this character will persist in additional specimens. Seen from above (fig. 430), the lip is 66 mm. wide from one gular suture to the other, and continues backward 32 mm. The entoplastron is diamond-shaped, 55 mm. long, 65 mm. wide and 11 mm. thick. It supports the hinder portion of the gular scutes, but no part of the pectoral scutes.

The hyoplastra occupy 72 mm. of the midline; the hypoplastra, 93 mm.; the xiphiplastra, 78 mm. The hinder lobe of the plastron is 107 mm. long; its width at the base is 145 mm. The upper surface of the hypoplastron (fig. 431) behind the inguinal buttress was covered with horny epidermis as far inward as the buttress extends, 31 mm. In all accessible specimens of *E. wyomingensis* this surface is much narrower. The inner edge of the inguinal buttress arises from the floor of the plastron at a line not half-way from the free border of the lobe to the midline, resembling in this respect *E. wyomingensis*.

The gular scutes extend along the midline 42 mm.; the humerals, 42 mm.; the pectorals, 42 mm.; the femorals, 56 mm.; the anals, 55 mm.

The species differs from all others of the genus, so far as known, in having the humero-pectoral sulcus cross behind the entoplastron.



FIGS. 432–435.—*Echmatemys ocyrrhoë*. Portions of type.

432. Carapace. ×¼. 433. Plastron. ×¼.
434. Upper surface of anterior lobe of plastron. ×½.
435. Upper surface of inguinal region of plastron, showing base of inguinal buttress and free border of hinder lobe. ×½.

Echmatemys ocyrrhoë sp. nov.

Figs. 432–435.

Two specimens in the American Museum of Natural History represent this species, No. 5933 and No. 5954. Of these, No. 5933 is taken as the type. It was collected in 1903 by Mr. Walter Granger in the Bridger Eocene beds at Church Buttes, Wyoming. No. 5954 was collected by the writer in 1903, in the western portion of Grizzly Buttes, Wyoming. Both specimens therefore come from the lower part of the horizon B of the Bridger beds, the specimen from Church Buttes belonging probably to a slightly lower level.

No. 5933 presents the shell nearly complete. The second suprapygal, most of the pygal, the eleventh peripheral of the right side and the distal ends of the eighth pair of costals are wanting. No. 5954 furnishes the plastron backward as far as the hypoxiphiplastral suture and various portions of the carapace, including the hindermost peripherals, but not the pygal.

The type, No. 5933, measures, from the front of the plastron to the rear, 280 mm. The length of the carapace (fig. 432) is 302 mm. The width in a straight line is 223 mm., thus being 74 per cent. of the length. The shell has been little, if any, crusht downward, and the height is now 108 mm. The front is slightly incurved in front. The anterior border is subacute, and the anterior peripherals thicken rapidly. The surface of the shell is smooth.

Dimensions of neurals.			Dimensions of costal bones.		
No.	Length.	Width.	No.	Width of proximal end.	Width of distal end.
1	37	24	2	29	35
2	29	28	3	31	25
3	30	26	4	25	40
4	28	25	5	33	18
5	29	22	6	21	35
6	21	28	7	19	25
7	18	26			
8	12	16.5			

The neurals are rather broad, having the dimensions shown in the table herewith.

The nuchal is 48 mm. long, 37 mm. wide at the free border, and 63 mm. where widest.

The costal plates behind the first pair are differentiated so that the proximal ends are alternately narrower and wider, while the distal ends are alternately wider and narrower. The dimensions of the costal plates are given in the table above.

The table below shows the dimensions of the peripherals, the vertebral scutes, and the marginals.

The height of the third peripheral is only 44 per cent. of the height of the first costal near its hinder border. The width of this costal is 70 per cent. of its height.

The nuchal has a length of 14 mm. and a width of 13 mm. The vertebral scutes, except the first, are of moderate width.

Dimensions of peripherals.				Dimensions of vertebral scutes.				Dimensions of marginals.			
No.	Height.	Width of free border.	Width of upper border.	No.	Length.	Width anteriorly.	Greatest width.	No.	Height in front.	Greatest height.	Length at free border.
1	34	35	17	1	57	80	80	1	14	23	31
2	32	35	18	2	57	45	61	2	23	26	33
3	34	37	32	3	61	38	53	3	20	20	33
6	38	39	37	4	66	41	58	4	20	22	37
8	43	36	25	5	50	34	..	7	30	33	37
								8	33	37	36

The anterior lobe of the plastron (fig. 433) has a length of 76 mm., and a width of 113 mm., at the base. The borders continue straight forward to the suture between the hyoplastron and the epiplastron, then curve toward the lip. The latter is 49 mm. wide, truncated and provided with a short stout tooth on each side. It extends as far in front as the border of the nuchal. The greatest thickness of the epiplastral bones is 13 mm. The thickening on the upper surface (fig. 434) extends backward 24 mm. The horn-covered surface is 18 mm. wide, becoming reduced to 16 mm. at the hyoepiplastral suture. The entoplastron is 47 mm. long and 53 mm. wide. The anterior buttresses ascend only about one-third the distance from the lower to the upper border of the first costals.

The bridge has a width of 118 mm. The hypoplastrals, in the midline, just behind the suture with the hyoplastrals, are 13 mm. thick. This is reduced very little toward the anterior and the posterior buttresses.

The hinder lobe has a length of 90 mm. and a width of 126 mm. The buttresses are broad. The beveled surface (fig. 435) on the upper side of the hinder lobe is of only moderate width, 19 mm. at the suture with the xiphiplastral. The posterior notch appears to have been rather shallow.

The gular scutes are 40 mm. long; the humerals, 33 mm.; the pectorals, 48 mm.; the abdominals, 73 mm.; the femorals, 38 mm.; the xiphiplastrals, at the midline, 45 mm. The axillary scutes are quadrilateral and fail by 15 mm. of extending backward to the fifth marginals. The inguinals lack the same distance of reaching to the sixth marginals.

No. 5954 is of almost exactly the same size as No. 5933, the length of the plastron to the hypoxiphiplastral suture being 218 mm. It varies in slight degrees from the type. The neurals

present are a little narrower, as are also the vertebral scutes. The greatest thickness of the nuchal bone is 16 mm. The ninth peripheral is 48 mm. high, 35 mm. wide at the free border and 23 mm. wide at the upper border. Its greatest thickness is 13 mm. This and the other hinder peripherals thin out to an acute border. The pygal is missing but the eleventh peripherals show that it had a height of 23 mm. and that its right and left sides were convex. The heads of the ribs of these specimens had a diameter of 8 mm.

The plastron differs in having a slightly narrower anterior lobe, 108 mm., a narrower hinder lobe, 117 mm., and a narrower lip, 41 mm. The entoplastron is 38 mm. long and 50 mm. wide. In both specimens the anterior lobe is very short in proportion to its width, being only 67 per cent. thereof.

The respects in which this species differs from *E. ægle* are stated under the species just named. *E. septaria* differs in the expanded anterior lobe, in the greatly thickened epiplastral bones, and in the contracted lip. The acute or subacute anterior border of the carapace of *E. ocyrrhoë* distinguishes it from *E. shaughnessiana.*

E. ocyrrhoë differs from *E. haydeni* in having the first vertebral scute much broader in front and rapidly narrowing posteriorly. The other scutes are as broad as long or nearly so; while in *E. haydeni* they are much longer than broad. *E. stevensoniana* is a relatively narrower shell, the width being only a little over two-thirds of the length; and more pointed in front and behind. The anterior border of *E. stevensoniana* is more acute than in *E. ocyrrhoë* and the suture between the first and second peripherals is 14 mm. thick, instead of 16.5 mm. The epiplastral lips of the two species are different. Comparisons with *E. cyane* are to be found under the latter species.

Echmatemys ægle sp. nov.

Figs. 436–441.

Two specimens represent at present this species. These were obtained in the Bridger beds, near Bridger, Wyoming, in 1903. Of these, one, No. 5909 of the American Museum of Natural History, is made the type. The locality where obtained is the western portion of Grizzly Buttes and the level is the lower portion of horizon B.

The specimen is represented by the complete plastron, the anterior 5 pairs of costal plates, the sixth costal plate of the right side, and a few peripherals. The nuchal bone is missing.

An estimate based on the plastron makes it probable that the carapace had a length of 330 mm. The surface is smooth, except for some longitudinal striations on the neural bones. The sulci bounding the epidermal scutes are rather deeply and uniformly imprest. The tables below give the dimensions of the neurals and of the vertebral scutes, so far as presented.

Dimensions of neurals.

No.	Length.	Width.
1	40	26
2	30	27
3	34	28
4	30	27
5	30	27
6	20	29

Dimensions of vertebrals.

No.	Length.	Width in front.	Greatest width.
1	..	82±	82±
2	66	42	75
3	68	40	66
4	..	45	70

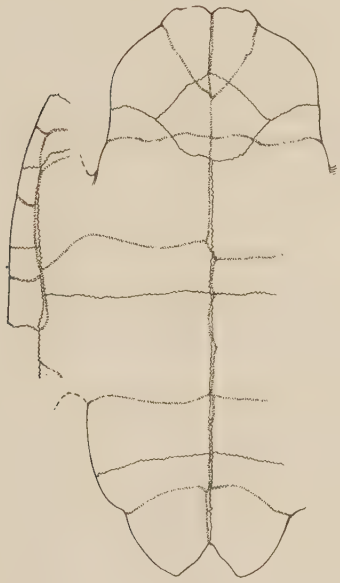
There is little difference as respects width between the proximal and the distal ends of the costal plates.

The first right peripheral is represented by that portion in front of the costo-marginal sulcus. Its free border is acute at the end next the nuchal bone but rather obtuse at the end next to the second peripheral. The extent of the free border is 38 mm. The greatest height of the second marginal scute was about 29 mm. The greatest thickness of the bone is 12 mm. A part of the right third peripheral is present and will be referred to below. The fifth peripheral is present and shows an angular ridge, along which the upper side of the shell past abruptly into the lower side. This peripheral rises above the ridge mentioned a distance of 35 mm. and it has a width of 40 mm. The seventh peripheral has a length of 40 mm. along the free border. Its upper border is broken away. The maximum thickness of the end articulating with the eighth is 13 mm., but it may have suffered some compression. The eighth peripheral measures 33 mm. along the free border and it rises to a height of 45 mm.

The vertebral scutes are broad and urn-shaped, quite like those of *E. naomi.* The table above gives the dimensions.

As shown by the fifth, seventh, and eighth peripherals the costo-marginal sulci ran near the costo-peripheral sutures, being distant 8 mm. or less.

As stated previously, the plastron (fig. 436) has a total length of 300 mm. The anterior lobe measures 87 mm. in length and has a width of 124 mm., the length thus being 70 per cent. of the width. It contracts a little in front of the axillary notch, then runs directly forward some distance in front of the hyoepiplastral sutures, then curves rapidly to the lip. The latter is 49 mm. wide. On each side it presents a stout tooth. Behind these teeth the thickness of the bones is 11 mm. The thickened portion of the epiplastral (fig. 437) continues backward 26 mm. Outside of the gular sutures, on the upper side, the horn-covered surface is 18 mm. wide, increases to 20 mm., and is reduced at the hyoepiplastral suture to 16 mm. The entoplastron is 35 mm. long and 60 mm. wide. The anterior buttresses arise some 15 mm. or more within the border of the anterior lobe and rise to a height of at least 63 mm. They are about 30 mm. wide and 7 mm. thick. The width of the bridge is 132 mm.



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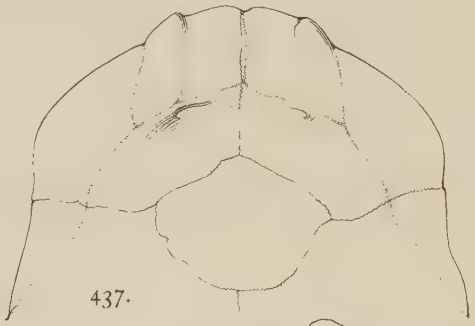

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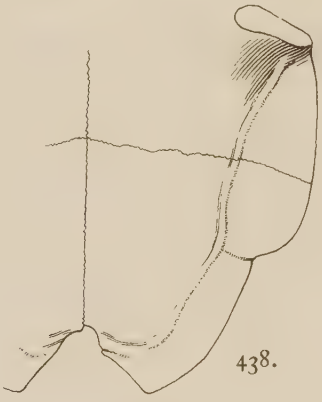


438.

FIGS. 436–438.—*Echmatemys ægle*. Plastron of type.

436. Plastron. ×¼. 437. Upper surface of anterior lobe. ×½.
438. Upper surface of hinder lobe of plastron. ×½.

The hinder lobe is 90 mm. long and 126 mm. wide at the base, the length being thus 71 per cent. of the width. It is rather conspicuously notcht at the outer ends of the femoro-anal sulci. The notch in the rear is rather deep, 13 mm., and its width is 36 mm. The beveled area on the upper side of the hinder lobe (fig. 438) commences near the outer border of the buttress, increases in width to the hypoxiphiplastral suture, where it is 23 mm. wide, and then diminishes to 10 mm. The bases of the posterior buttress extend more than half-way from the border of the hinder lobe to the midline. Their summits are fully 65 mm. above the upper surface of the hinder lobe. They are 25 mm. or more wide and 7 mm. thick at half their height.

The gulars have a length, on the midline, of 47 mm.; the humerals, 22 mm.; the pectorals, 58 mm.; the abdominals, 72 mm.; the femorals, 47 mm.; the anals, 34 mm.

The portions of the third and fourth peripherals present show that the axillary scutes fail to reach the fifth marginal scute by 20 mm. The inguinal scutes are not well displayed.

A second specimen referred to this species is No. 5976 of the American Museum. It was obtained in 1903, in the western portion of Grizzly Buttes and in level B. It is represented by

the anterior three-fourths of the shell. It had almost exactly the same size as the preceding specimen, the length from the front of the carapace to the xiphiplastron being 233 mm. The specimen has been considerably crusht downward. It furnishes the whole front of the carapace (fig. 439), most of which was wanting in the type. The nuchal has a maximum width of 82 mm., but this would be less if the bone were archt as usual. The free border of the bone measures 39 mm. The front border of the carapace is very acute to the beginning of the second peripheral. The accompanying table shows the dimensions of the neurals.

Dimensions of neurals.			Dimensions of costals.		
Neural.	Length.	Width.	Costal.	Proximal width.	Distal width.
1	38	23	2	32	41
2	32	27	3	39	26
3	36	26	4	29	38
4	32	27	5	30	23
5	32±	28	6	20	34

The costal plates of this specimen are modified more than those of the type. The widths of the ends are given in the table above. The width of the first costal is equal to 65 per cent. of its height near the hinder border.

The dimensions of some of the peripherals and of the vertebral and marginal scutes are shown below in tabular form.

The maximum thickness of the nuchal and the first peripheral at their suture is 12 mm.

Dimensions of peripherals.				Dimensions of vertebrals.				Dimensions of marginals.			
No.	Height.	Width of free border.	Width of upper border.	No.	Length.	Width in front.	Greatest width.	No.	Height in front.	Greatest height.	Length of free border.
1	40	35	20	1	55	79	79	1	19	24	31
2	38	37	19	2	65	39	70	2	23	28	35
3	39	40	28	3	68	38	67	3	20	21	40
4	36	41	38	4	..	45	80±	4	21	25±	35

The first and second peripherals are 12 mm. thick at their articulation. The maximum thickness of the hinder articular end of the seventh neural is 15 mm.

The vertebral scutes resemble those of the type. The nuchal scute is 17 mm. long, 10 mm. wide in front, expanding to 18 mm. behind. The marginal scutes have the dimensions given in the table above.

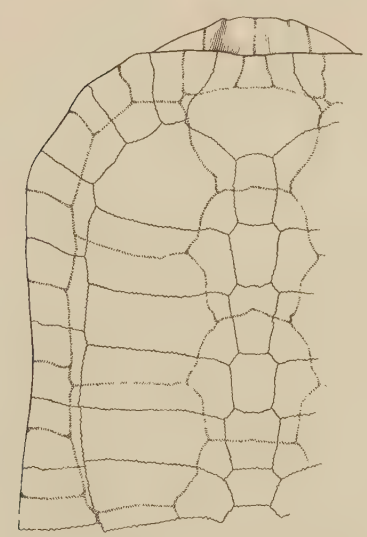


FIG. 439.—*Echmatemys ægle.* Carapace. ×¼. No. 5976 A. M. N. H.

The surface of the carapace is smooth, except that on the neurals and proximal ends of the costals there are fine longitudinal striations.

From the plastron the xiphiplastrals are missing.

The length of the anterior lobe is 82 mm.; the width of the base is 130 mm. The length is therefore only 63 per cent. of the width. It is possible that this is a sexual difference, the lobes of the type being somewhat narrower. The width of the epiplastral lip is 54 mm. The upper surface of the front of the lobe resembles that of the type, except that there is a broad channel on each side of the midline, extending out to the lateral tooth. The horn-covered areas of the upper surface resemble those of the type. The bridge is 130 mm. wide.

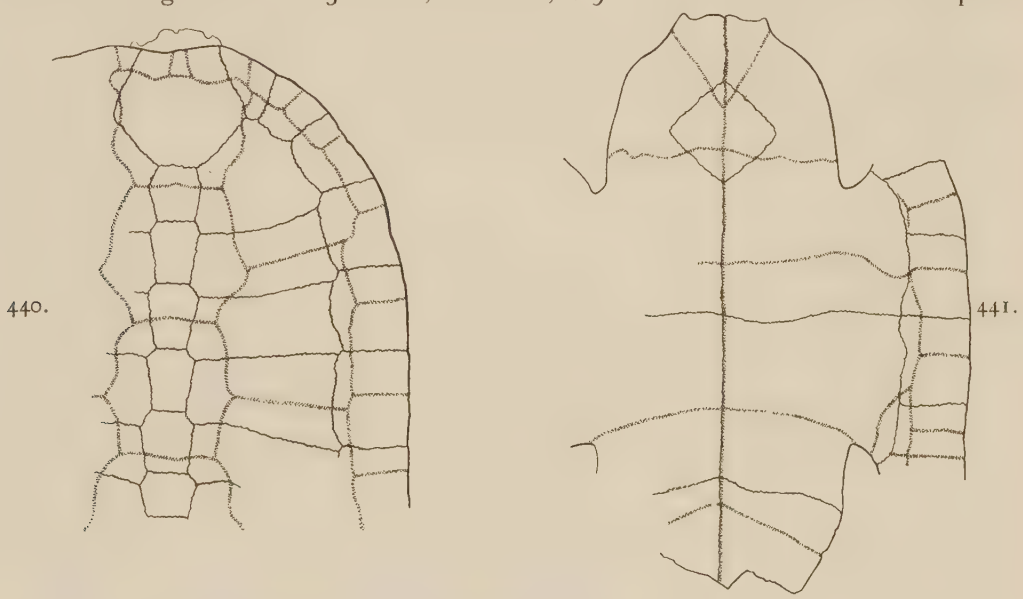
The hinder lobe is 141 mm. wide. It will be observed that both the anterior and the posterior lobes are wider than those of the type. The beveled surface on the upper side of the hinder lobe is 25 mm. wide.

The gulars have a length of 40 mm.; the humerals, 23 mm.; the pectorals, 64 mm.; the abdominals, 79 mm. The axillary scutes fail of reaching the fifth marginal by 14 mm. The inguinal scutes extend forward so as barely to meet the sixth marginals.

This species appears to be most closely related to *E. ocyrrhoë*. In *E. ægle*, as compared with *E. ocyrrhoë* the vertebral scutes are wider and more distinctly urn-shaped, the neurals are broader, the carina over the bridge, on the peripherals, appears to have been more angular, the beveled areas on the upper side of the epiplastron are somewhat wider; those on the upper side of the hind lobe are considerably wider. The front border of the carapace of *E. ægle* is more acute and the bones are not so thick. As shown by the specimens, the eighth peripheral of *E. ægle* is only 12 mm. thick where it joins the seventh, whereas in *E. ocyrrhoë* it is 17 mm. thick. In the second specimen of *E. ægle* the thickness of this bone is 15 mm. In *E. ocyrrhoë* the inguinal scutes did not reach the sixth marginals. As compared with *E. ocyrrhoë*, No. 5954, the rib-heads are much stouter, the diameters of the former being about 10 mm.; in the latter about 8 mm. The thickness of the first costal plate at the angle where it joins the nuchal and the first peripheral is 9 mm. thick in *E. ægle*, 11 mm. in *E. ocyrrhoë*, No. 5954; the latter being, besides, a smaller individual. In *E. ægle*, No. 5976, the thickness of peripherals one and two at their articulation is 12 mm.; in *E. ocyrrhoë*, 17.5.

E. ægle resembles *E. naomi* in the form of the vertebral scutes, but is distinguisht therefrom by numerous characters.

No. 10073 of the paleontological collection of Princeton University appears to belong to this species. Its length is close to 300 mm., the width, 215 mm. The center of the carapace is



FIGS. 440 AND 441.—*Echmatemys ægle*. Carapace and plastron. ×¼. No. 11515 Princeton University.

440. Carapace. 441. Plastron.

missing, removing most of the neurals and vertebral scutes. The first vertebral is 55 mm. long, 78 mm. wide in front, 36 mm. behind. The fourth vertebral is 70 mm. wide where widest—contracting behind to 27 mm. The fifth had a maximum width of 64 mm.

The anterior lobe of the plastron contracts very little from the axillary notches to the hyoepiplastral suture; then rapidly to the lip. There is a sharp notch at each side of this. No. 11515 (figs. 440, 441) of Princeton University, lacking the hinder part of the shell, appears to belong here. The nuchal scute is 80 mm. wide near the front, narrows to 64 mm., widens again to 70 mm., then narrows to 43 mm. at the hinder end. The other vertebrals are expanded at the middle of the length. The sulci are deeply imprest. The length from the front of the carapace to the hinder border of the sixth neural is 255 mm. The axillary and the inguinal buttresses are strongly developt, rising high on the inside of the carapace. The former extends inward from the free border of the anterior lobe about 25 mm. The inguinal buttresses extend inward from the free border of the hinder lobe 32 mm. They articulate with the fifth and sixth costals.

Echmatemys naomi sp. nov.

Plate 51, figs. 1, 2; text-figs. 442–444.

The type of the present species is a finely preserved shell which was collected by the American Museum expedition of 1903, in the Bridger beds of Wyoming. The locality is Little Dry Creek, near the western part of Grizzly Buttes and the level is the lower part of horizon B. The shell has suffered slight downward crushing, but none of the characters have thereby been obscured. The number of the specimen is 5975.

Element.	Length.	Width.
Nuchal	55	70
Neural 1	47	28
Neural 2	43	33
Neural 3	33	33
Neural 4	32	33
Neural 5	33	31
Neural 6	26	29
Neural 7	20	29
Neural 8	17	25
Suprapygal 1	31	34
Suprapygal 2	37	70
Pygal	31	39

The total length of the carapace (plate 51, fig. 1; text-fig. 442) is 360 mm. The width taken across the middle is 263 mm., and this is the greatest width. The front of the shell is in no way contracted. The hindermost peripherals appear to have been slightly notcht at the sutures. The table gives the dimensions of the central row of bones.

The width of the free border of the nuchal is 42 mm. The costals present little that is novel. The proximal ends are usually of nearly the same width as their distal ends, except that the last three have their distal ends expanded somewhat.

The table below presents the dimensions of some of the peripherals. The height of the third peripheral is 53 per cent. of the hinder border of the first costal.

The nuchal and the first pair of peripherals have an acute free border. The greatest thickness of the first is 19 mm. The free border of the second is subacute and passes into the rounded free border of the third.

Dimensions of peripherals.				Dimensions of marginal scutes.				Dimensions of vertebrals.			
No.	Height.	Width of free border.	Width of costal border.	No.	Height in front.	Greatest height.	Length at free border.	No.	Length.	Width at anterior end.	Greatest width.
1	42	34	14	1	20	25	33	1	63	81	81
2	42	35	20	2	24	28	32	2	70	42	74
3	43	42	27	3	22	23	38	3	70	43	70
6	46	48	43	4	22	28	45	4	68	48	71
8	52	43	32	9	36	38	40	5	61	32	79

The posterior peripherals are flared moderately upward. They are rather thin and pass out into a sharp, thin, free border. The thickness of the ninth at the longitudinal sulcus is 9 mm.

The first costal is four-fifths as wide, fore and aft, as it is long on the hinder border.

The upper surface of the shell is very uneven. Large parts of the sulci run in very deep grooves. Between them the surface is usually rough and pitted. There is no keel. In the middle of the nuchal there is a slight, broad, rounded, longitudinal elevation and a similar one on the suprapygals and pygal. The sulcus running around the carapace on the nuchal, the peripherals, and the second suprapygal, lies in a deep groove. This groove has so weakened the peripherals in its course that the pressure has caused them to yield along this sulcus. The sulci between costals 1 and 2 and between 2 and 3 lie in very deep grooves, especially at their upper ends. The hinder ends of the sulci bounding laterally the three anterior vertebral scutes lie in deep and broad grooves. The sulci between many of the marginal scutes occupy deep grooves.

The nuchal has a length of 19 mm. and a width of 15 mm.

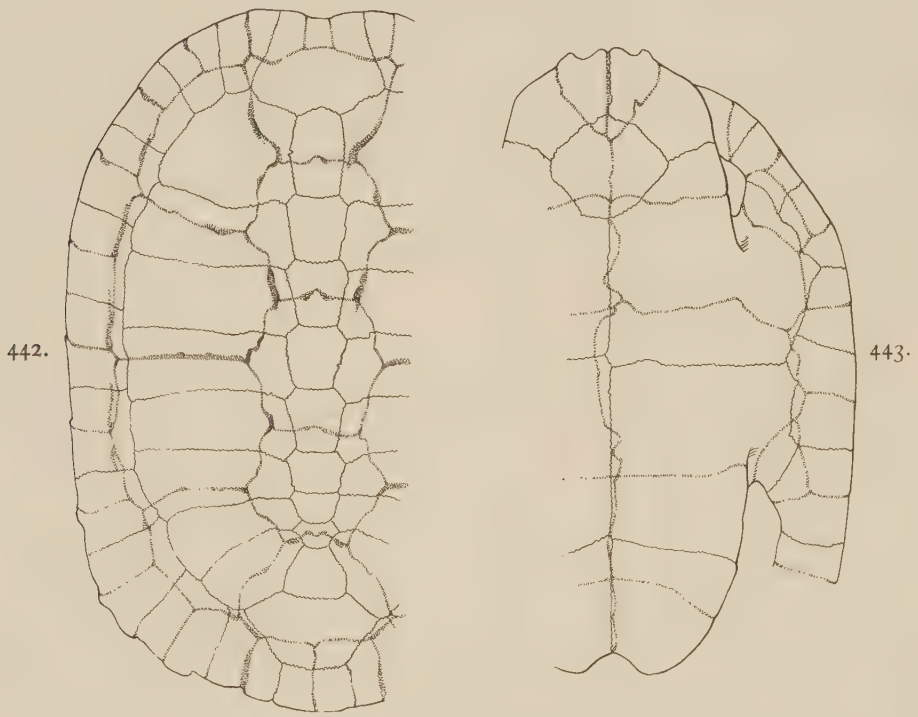
The dimensions of marginal scutes are shown in the table above.

The costo-marginal sulci run far below the costo-peripheral sutures.

The vertebral scutes are broad and rather strongly urn-shaped; their dimensions are presented in the table above.

The plastron (plate 51, fig. 2; text-fig. 443) has a total length of 326 mm. The front extends somewhat beyond the border of the carapace. The length of the anterior lobe is 96

mm.; its width 128 mm. The length then has a high ratio to the width, being 75 per cent. thereof. The lateral border runs nearly straight to a point some distance in front of the hyoepiplastral suture, then rounds rapidly to the lip. The lip is 53 mm. wide. It projects little and is furnisht with a right and a left lateral tooth and 2 closely placed median teeth. Between the lateral tooth and the midline the upper surface of this lip is considerably excavated. The thickening of the epiplastrals on the upper surface (fig. 444) extends backward 30 mm. The greatest thickness of these bones is 12 mm. The median space between these thickenings on the upper surface is somewhat excavated. The free borders of the lobe are acute nearly to the lip. The beveled surface on the upper side of the epiplastrals has a width of only 12 mm. at the hyoepiplastral suture. The entoplastron is 50 mm. long and 60 mm. wide. The bridge has a width of 137 mm. The hinder lobe is 98 mm. long and 143 mm. wide at the base. The length of the lobe equals therefore about 69 per cent. of the width. There is a rather broad notch at the rear of the lobe. Its width is about 12 mm. The beveled surface on the upper



FIGS. 442 AND 443.—*Echmatemys naomi*. Carapace and plastron of type. $\times \frac{1}{4}$.

442. Carapace. 443. Plastron.

side of this lobe, at the hyoxiphiplastral suture, is 28 mm. wide. The bones here have a thickness of 13 mm.

The anterior buttresses appear to arise but a short distance within the free border of the base of the anterior lobe. The posterior buttresses reach inward from the border of the hinder lobe half-way to the midline.

The gulars are 47 mm. long; the humerals, 31 mm.; the pectorals, 60 mm.; the abdominals, 86 mm.; the femorals, 53 mm.; the anals, 38 mm. The humero-pectoral sulcus cuts across the hinder end of the entoplastron. The median longitudinal sulcus runs a very irregular course.

The axillary scute is large and its hinder end joins the fifth marginal for a distance of 13 mm. The inguinal scute is also large, its outer boundary being 38 mm. long, and lacking 12 mm. of reaching the sixth marginal.

From all other described species this differs in the depth of the channels in which run most of the carapacial sulci. From *E. stevensoniana* it differs also in having broader neurals and in its broader, urn-shaped, vertebral scutes. These scutes likewise distinguish it from *E. shaugh-*

nessiana. Furthermore, the free borders of the nuchal and first pair of peripherals are acute, while those of *E. shaughnessiana* are rounded. In the type of *E. shaughnessiana* the humero-pectoral sulcus passes behind the entoplastron; in *E. naomi*, across it.

In *E. septaria* the epiplastral lip is more contracted, the epiplastrals are very thick at the sides of the lip, and the anterior lobe expands in front of the base.

In *E. ocyrrhoë* the vertebral scutes are narrower, the anterior marginal scutes extend up farther on the peripherals, the costal plates have their opposite ends alternately wide and narrow, and the horn-covered surface of the upper side of the posterior lobe is relatively much narrower. *E. arethusa* has narrow vertebral scutes and a contracted epiplastral lip.

FIG. 444.—*Echmatemys naomi*. Upper surface of epiplastral lip of type. $\times\frac{1}{2}$.

E. ægle resembles *E. naomi* in respect to the neural bones and the form of the vertebral scutes. The sulci of the carapace are not in deep grooves. The lateral peripherals of *E. naomi* rise much higher above the margin of the carapace than those of *E. ægle*, the fifth of the former rising 46 mm., in *E. ægle* only 34 mm. On this peripheral of *E. naomi* the costo-marginal sulcus runs 15 mm. below the upper border of the bone; in *E. ægle* only 9 mm. below. The axillary scutes of *E. naomi* are more strongly developt than in *E. ægle*, reaching backward and widely joining the fifth marginals; while in *E. ægle* they lack much of reaching the fifth marginals. On the other hand, the inguinal scutes of *E. ægle* extend forward to the sixth marginals, while those of *E. naomi* do not reach the marginals just named. The epiplastral lip is quite different in the two species, and the anterior plastral lobe of *E. ægle* is relatively wider. The neurals of *E. naomi* are considerably broader than those of *E. ægle*.

Dedicated to one of the world's noble women (Ruth I–IV).

Echmatemys pusilla sp. nov.

Figs. 445, 446.

Emys wyomingensis, LEIDY, Contrib. Ext. Vert. Fauna West. Terrs., 1873, p. 148, No. 13.

This name is bestowed on a small turtle which was obtained by the writer in 1903 at Grizzly Buttes, Wyoming. The number of the specimen in the American Museum is 5992. The level is that known as B. The type specimen affords the greater part of both carapace and plastron. The shell gives evidences of having been immature. The total length of the carapace in a straight line appears to have been close to 125 mm. The upper shell (fig. 446) was apparently quite convex.

The nuchal bone has a length of 24 mm.; a width of 19 mm. in front and an extreme width of 28 mm. The free border is acute. The greatest thickness is 4 mm.; the border for articulation with the first peripheral is slightly less than this. The neurals are broad. Their dimensions are shown in the table; also those of the vertebral scutes.

Dimensions of neurals.			Dimensions of vertebral scutes.			
No.	Length.	Width.	No.	Length.	Width in front.	Greatest width.
1	14	11	1	25	30	30
2	11	12	2	26	17.5	30
3	12.5	13	3	25	22	30
4	11	14	4	25±	22±	24±
			5	..	15±	..

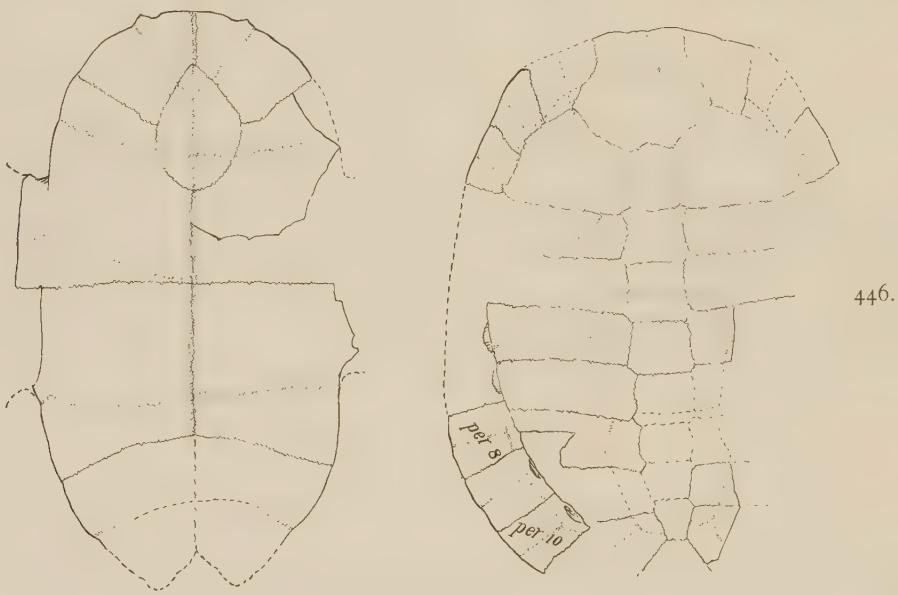
The second neural is octagonal. The next two are hexagonal, with the postero-lateral angles truncated. From the forms of the contiguous costals it appears that the fifth neural had the same form as the fourth, that the sixth was four-sided, the seventh and the eighth hexagonal, with the antero-lateral angles truncated.

All the costals are represented in whole or part. They are thin, about 2 mm. distally, thickening proximally to about 3.5 mm. On the visceral surface of those of the first pair the axillary buttresses ascend a considerable distance above the lower borders. At the

thickened junction of the fifth and sixth costals is an excavation for the inguinal buttress. This ascended about one-third the distance from the lower border of the costal to the neural border.

The first, second, and third peripherals have acute free borders and remains of the bridge peripherals show that a sharp carina from the third peripheral continued backward to the hinder peripherals. The costo-marginal sulci run just below the costo-peripheral sutures. The second peripheral has a height of 15 mm.; the third, of 12 mm.; the eighth and ninth, of 15 mm. The eighth, ninth, and tenth are only slightly concave above. In fig. 446 the last-mentioned peripherals are placed too near the midline. Most of the vertebral scutes are broader than long.

The plastron (fig. 446) lacks the hinder extremity. Its total length was not far from 110 mm. The anterior lobe is 38 mm. long, 58 mm. wide. The epiplastral lip is truncated, 25 mm. wide, and furnisht with a blunt tooth on each side. On the upper side the lip is thickened backward for a distance of 16 mm., where there is a sudden offset. The thickness of the lip



FIGS. 445 AND 446.—*Echmatemys pusilla.* Plastron and carapace of type. $\times \frac{2}{3}$.

445. Plastron. 446. Carapace.

is about 9 mm. from one side to the other. The entoplastron is elongated and pointed in front. Its length is 26 mm., its width 8 mm. The hinder lobe of the plastron has a width of 61 mm. at the base. Its free borders are acute. The horn-covered surface on the upper side is 11 mm. wide and shows distinct impressions of the growth of the scutes. The thickness at the hypo-xiphiplastral suture is 6 mm. The inguinal buttress extends inward from the free border of the lobe little more than one-third the distance to the midline.

The gular scutes overlap somewhat the entoplastron, as do likewise the pectorals. The latter scutes reach backward to the hyohypoplastral suture, a condition not known in other species of the genus.

In his monograph of 1873, as cited at the head of this article, Dr. Leidy described, as the young of his *Emys wyomingensis*, a small turtle which had been sent to him from Fort Bridger, Wyoming, by Dr. Carter. This specimen is now in the collection of the Philadelphia Academy.

The specimen agrees in all essential respects with the type of *E. pusilla*. It furnishes a large part of both carapace and plastron. The nuchal bone and all the neurals are present, except the fifth. There are 2 suprapygals. Both first costals are preserved and wholes or parts of all those of the left side. The first right peripheral is in its place. All the peripherals of the left side are present, except the fourth and sixth. The pygal is missing. Of the plastron

all was secured, except the right hyoplastron, a small part of the right hypoplastron, and the whole xiphiplastron.

The length of the carapace was not far from 110 mm. There is a sharp keel on the nuchal. This is carried back on the neurals, but is obtuse until the seventh is reacht. On this, but especially on the eighth and on the suprapygals, it is sharp. The neurals are broad, as in the type. The third, not the second, is octagonal. The seventh is 6 mm. long and 12 mm. wide; the eighth, 6.5 mm. long and 11 mm. wide, and is crost by the sulcus between the fourth and the fifth vertebral scutes. The first suprapygal is 8 mm. long on the midline, 6 mm. wide in front and 10 mm. behind; and is deeply excavated behind for the second suprapygal. This is small, only 5 mm. long and 7 mm. wide.

The plastron has a total length of 103 mm. The anterior lobe is 30 mm. long and 54 mm. wide at the base. The epiplastral lip is 24 mm. wide, acute-edged, extends backward on the upper side 13 mm., and is 6 mm. thick. The upper surface is quite strongly imprest by the lines of growth of the horny scutes. The axillary buttresses extend but a little distance within the free borders of the base of the lobe. The entoplastron is long and narrow, as in the type, being 22 mm. long and 18 mm. wide. The bridge is 36 mm. wide.

The hinder lobe is 35 mm. long and 55 mm. wide at the base. In the rear there is a rather deep notch. The free borders are acute. On the upper side, at the hypoxiphiplastral suture, the horn-covered surface is 10 mm. wide. Here the bones are 5 mm. thick. The inguinal buttress extends inward about one-third the distance from the free border of the lobe to the midline.

Vertebral.	Length.	Width in front.	Greatest width.
1	24	25	25
2	24	16	26
3	24±	18	26
4	22±	..	26
5	..	14	..

The sulci are very distinct. The dimensions of the vertebral scutes are given in the table herewith.

The gulars barely reach the entoplastron. The humero-pectoral sulcus crosses at about the middle of the length of the entoplastron. As in the type, the pectoro-abdominal sulcus is carried back nearly to the hyohypoplastral suture. The femoro-abdominal sulcus crosses the lobe in a nearly straight line. The femorals measure along the midline, 19 mm.; the anals, 13 mm.

This species resembles in several respects *Clemmys morrisiæ*. It differs, however, in having the free borders of the second and third peripherals acute, instead of obtusely rounded, and in having the inguinal buttresses rise well within the free border of the plastron. The epiplastral lip resembles in form closely that of *C. morrisiæ*, and it is markt on its upper surface with similar ridges, though not so strongly developt.

Echmatemys? latilabiata (Cope).

Emys latilabiatus, Cope, Proc. Amer. Philos. Soc., xii, 1872, p. 471; Sixth Ann. Report U. S. Geol. Surv., 1872 (1873), pp. 625, 626; Vert. Tert. Form. West, 1884, p. 138.
Emys latilabiata, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

The present species has never been figured. In his work on the Vertebrata of the Tertiary Formations of the West, cited above, Professor Cope stated that the type had been mislaid. So far as the present writer knows, it has not been recovered up to the present time. It is possible that at some time another specimen may be discovered that can be identified by means of the description. The striking characters of the species, so far as indicated by Cope's description, are the relatively great breadth of the shell and the wide epiplastral lip. The following is Cope's latest description:

Represented by a perfect specimen of a tortoise of a broadly oval form, and somewhat terrestrial habit. Its prominent characters are to be seen in the plastron, of which the posterior lobe is deeply bifurcate. The anterior lobe is peculiar in the unusual width of the lip-like projection of the clavicular ("episternal") bone, which is twice as wide as in *E. wyomingensis*, and not prominent. Bones all smooth; margins of lobes of plastron thickened.

There are three scars, perhaps, of muscular insertions near the posterior margin of the plastron, an oval one opposite to each lobe, and a round one opposite to the notch.

As compared with *E. septaria* this species has no such septa nor sculpture; the emargination of the plastron is more open, and the lip much shorter and wider.

Measurements.

	Meter.
Length of carapace	0.255
Width of carapace	.250
Width of lip of plastron	.060
Depth of posterior notch	.020

The temporary misplacement of the typical specimen of this species prevents my giving other than my original description.

From near Black's Fork of Green River.

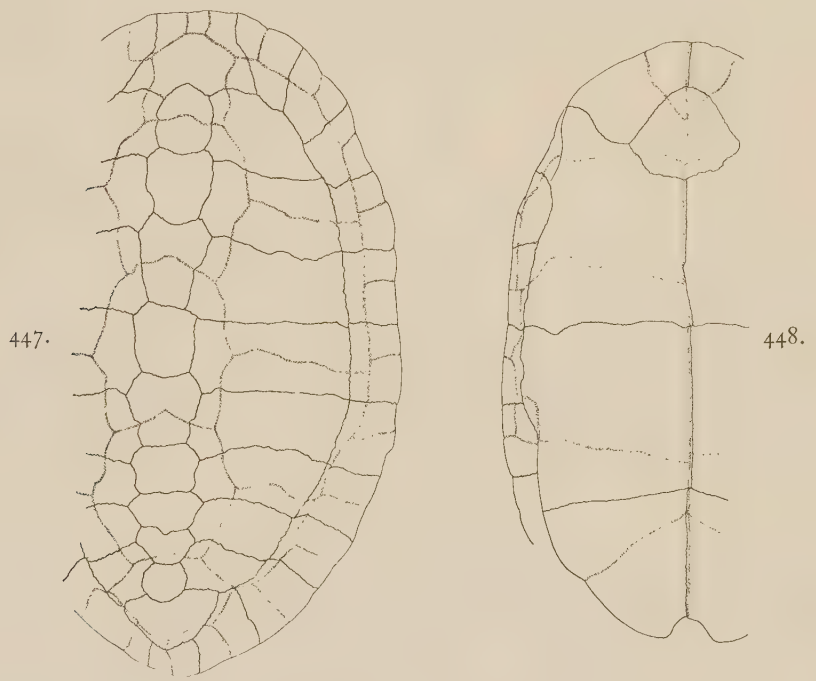
This species was obtained in horizon B of the Bridger Eocene.

Echmatemys callopyge sp. nov.

Plate 52, figs. 1, 2; text-figs. 447, 448.

As type of this species the American Museum of Natural History possesses a large and complete shell, No. 2087. It was collected in the year 1895, in the middle Uinta deposits near White River, Utah.

The shell is slightly crusht over toward the left side, a part of the right side is broken in, and a portion of the left margin is somewhat damaged; but there is nothing to prevent the



FIGS. 447 AND 448.—*Echmatemys callopyge*. Carapace and plastron of type. $\times \frac{1}{5}$.

447. Carapace. 448. Plastron.

determination of all the external characters that the shell offers. It would require the inflicting of much injury on the specimen to reach and examine the axillary and inguinal buttresses. Hence their condition is not certainly known.

The form of the carapace (plate 52, fig. 1; text-fig. 447) is elongated oval, rounded in front and pointed behind, with the median portion high and vaulted. The plastron is broad and it left but little space for the exit of the limbs.

The length of the carapace, in a straight line, is 438 mm.; its width is 270 mm.; its height is now 153 mm. The latter dimension was doubtless somewhat greater during the life of the animal. There is a rather broad elevation running along the midline of the first vertebral scute and another on the last vertebral; elsewhere there is no indication of any carina. The margin of the carapace behind the inguinal notches is thin and comes to a sharp edge. This

region is not at all serrated; but it is somewhat flared upward. The surface of the shell is smooth. The sulci are narrow but rather deeply impressed.

The neural plates are in general hexagonal, with the broad end forward. The second to the fifth, inclusive, have the anterior end more or less concave. Most of the neurals are longer than broad, but the posterior are broader than long. The table herewith gives the dimensions of the neurals.

Dimensions of ueurals.			Dimensions of vertebrals.				Dimensions of marginals.			
No.	Length.	Width.	No.	Length.	Width in front.	Greatest width.	No.	Height in front.	Greatest height.	Length at free border.
1	52	33	1	75	52	52	1	18	32	40
2	43	39	2	89	47	85	2	26	29	47
3	58	43	3	88	52	82	3	21	27	46
4	41	37	4	96	59	87	9	45	47	45
5	41	44	5	74	44	100±				
6	30	40								
7	29	45								
8	28	34								

The nuchal is 68 mm. long, 50 mm. wide at the free border, and has a maximum width of 80 mm. The first suprapygal is 33 mm. long and 29 mm. wide; the second 42 mm. long and 90 mm. wide. The pygal has a length of 30 mm. and a width of 40 mm. The free border of the nuchal and the first peripherals is acute.

The peripherals are high. In front, they extend upward above the margin of the shell about 46 mm.; laterally about 62 mm.; at the inguinal notch, about 70 mm.; the most posterior, about 28 mm.

All the vertebral scutes are longer than broad, except the fifth. The first is unusually narrow. The sides of the median three are bracket-shaped. The dimensions are given in the middle table above.

Besides the nuchal scute, there are on each side the usual 12 marginals. These do not rise to the upper borders of the peripheral bones. The nuchal scute is very narrow, only 14 mm.; its length is 16 mm. The dimensions of the marginals are shown in the table above.

The plastron (plate 52, fig. 2; text-fig. 448) has a total length of 410 mm. The anterior lobe is 116 mm. long and 174 mm. wide. The posterior lobe is 135 mm. in length and 198 mm. in width. The bridge is 155 mm. wide. The anterior lobe is slightly contracted just in front of the axillary notch; then expands a little to the ends of the epiplastra; then curves slowly to the truncated lip. The latter is unusually narrow, having a width of only 38 mm., being less than one-fourth of the width of the anterior lobe. It is markt outwardly on each side by a stout tooth, mesiad of which there is a notch. In the latter are three smaller teeth. On the upper side of the bone there is, along the midline, a prominent ridge, 48 mm. long and bounded on each side by a valley, the latter opening in front at the notch of the lip. At the hinder end of the ridge is a transverse ridge, which passes outward and backward. About the middle of its length the epiplastron has a thickness of 15 mm.

The length of the entoplastron is 72 mm.; the width, 74 mm. The hyoplastra are 94 mm. along the midline, and each extends laterally about 104 mm. The hypoplastra join along the midline for a distance of 100 mm. The xiphiplastrals meet along the midline 85 mm. The notch between their hinder ends is 15 mm. deep; the distance between the tips is 34 mm.

There are the usual scutes on the plastron. The gulars, taken together, are 64 mm. wide in front. They extend backward well on the entoplastron, their median length being 72 mm. The humerals meet along the midline for a distance of 35 mm. The pectorals encroach on the entoplastron. The suture between them is 74 mm. long. The abdominals extend along the midline for 110 mm. The femorals are only 38 mm. fore and aft at the midline; but 93 mm. at their outer ends. The anals occupy 66 mm. of the midline. On account of some crushing the axillary scute can not be made out. It is certain, however, that it failed by at least 25 mm. to reach backward to the fifth marginal. The inguinal scute lackt about 27 mm. of extending forward to the sixth marginal.

The very narrow first vertebral scute distinguishes this species from all others, especially from *E. uintensis*, which also comes from the Uinta formation. From many species it is distinguisht by the rather broad vertebrals succeeding the first. The narrow epiplastral lip and the longitudinal ridge on the upper side of the symphysis are peculiarities. The femoral scutes are unusually narrow at the midline. The species resembles somewhat *E. septaria* (Cope), but the vertebral scutes of the two are different, and the epiplastron of *E. callopyge* appears not to have been so greatly thickened as in *E. septaria*.

Echmatemys uintensis sp. nov.

Plate 53, figs. 1, 2.

In the paleontological collection at Princeton University there is a fine, large shell of a species of *Echmatemys* which was collected in 1895, by Mr. J. B. Hatcher, in the middle Uinta formation, on White River, Utah. It bears the catalog number 11198. This shell is practically complete and but little crusht. The total length, in a straight line, is 460 mm.; the width, 295 mm.; the height above the bottom of the plastron, 160 mm. In outline the carapace is somewhat concave in front, rounded behind. The hinder peripherals flare slightly upward.

On the nuchal bone and the anterior neurals there is a slight ridge; and this reappears and is more prominent on the hinder third of the shell.

The nuchal bone is 67 mm. long and 107 mm. wide. It is excavated behind for the first neural. The neurals are relatively broad, the second, third, and fourth hexagonal; the fifth octagonal, joining the fourth, fifth and sixth costals; the sixth and seventh broadly hexagonal; the eighth nearly quadrate. The table shows the dimensions of the neurals.

Dimensions of neurals.			Dimensions of vertebral scutes.			
No.	Length.	Width.	No.	Length.	Width in front.	Greatest width.
1	60	45	1	70	112	112
2	43	42	2	115	80	102
3	50	42	3	91	80	81
4	50	43	4	78	75	94
5	34	47	5	86	43	132
6	30	42				
7	20	50				
8	25	30				

The first suprapygal is 37 mm. long, 21 mm. wide in front, and 42 mm. wide posteriorly. The second is 47 mm. long and 115 mm. wide.

The first peripheral has the free edges moderately acute, but toward the axillary notch the others become obtuse. All these rise above the free margin about 60 mm. The eighth peripheral is 67 mm. high. The pygal is 42 mm. wide and 38 mm. high.

The vertebral scutes are longer than wide with the sides nearly straight, except where the sulci dividing the costal scutes are given off. The dimensions of these scutes are given above.

The anterior suprapygal is 37 mm. long, 21 mm. wide in front, and 41 mm. behind. The second suprapygal is 49 mm. long, 105 mm. wide across the middle, 33 mm. where it joins the pygal. The hinder boundary of the fifth vertebral scute lies on the second suprapygal.

The axillary and inguinal buttresses rise high within the carapace, but the details are not known. They extend at their bases but a short distance inward beyond the free borders of the plastron.

The anterior lobe of the plastron is 120 mm. long and 200 mm. wide at the base. From the axillæ the width decreases slowly to just beyond the hyoepiplastral suture, then more rapidly by a sigmoid curve to the lip. The latter is 65 mm. wide and truncated. It projects little beyond the ends of the gulo-humeral sulci. As seen from below, it is convex from side to side; as seen from above, concave. The thickened portion of the lip continues backward 30 mm.; and behind it the thickness is not greatly reduced. The free border of this lobe is acute. On the upper surface of the bone the horn-covered surface is 23 mm. wide.

The entoplastron is diamond-shaped, 70 mm. long and 95 mm. wide.

The hinder lobe is 150 mm. long and 200 mm. wide at the base. The notch in the hinder end is 16 mm. deep and 55 mm. wide. The border of the lobe is acute. Seen from above, the beveled surface is 37 mm. wide at the hypoxiphiplastral suture; at the femoro-anal sulcus only 15 mm. At the inner border of the bevel the thickness is 20 mm.

The epiplastrals occupy 44 mm. of the midline; the hyoplastrals, 125 mm.; the hypoplastrals, 120 mm.; the xiphiplastrals, 8 mm. At the junction of the hyoplastrals and hypoplastrals, at the midline, the thickness is 17 mm.

Measured on the midline the gulars are 57 mm. long; the humerals, 40 mm.; the pectorals, 73 mm.; the abdominals, 115 mm.; the femorals, 70 mm.; the anals, 52 mm.; both the gulars and the pectorals encroach on the entoplastron.

In many respects this species resembles *E. wyomingensis* of the Bridger beds. It is, however, improbable that the latter species continued on into the Uinta epoch. Furthermore, differences are presented, notably in the greater width of most of the vertebral scutes.

Genus PALÆOTHECA Cope.

Species small, with thick and solid bones. A dorsal keel present. Scutal sulci deeply imprest. The epiplastral lip projecting and the inguinal buttress probably ascending above the borders of the fifth and sixth costals.

Type: *Palæotheca polycypha* Cope.

This hardly definable genus was establisht by Cope to contain his species *P. polycypha* and *P. terrestris*. These he afterwards referred to *Emys*. As there is neither evidence nor probability that the species belong to *Emys* as now understood, the species must be removed to some other genus. It is possible that they belong in *Echmatemys*, but of this there is little evidence. They are very imperfectly known species; and as the genus *Palæotheca* has been already establisht for them, it seems that no confusion or inconvenience will be produced in retaining them there until more is ascertained regarding their structure and relationships.

Cope suspected that these small turtles might be the young of species already described from adult remains, but he concluded that they had too many features of maturity to be merely young animals. Cope thought also that they showed relationships with the modern genera *Terrapene* (*Cistudo*) and *Testudo*; but there appears to be little probability of this.

Unfortunately the types of both the species here described are extremely fragmentary.

Palæotheca polycypha Cope.

Palæotheca polycypha, Cope, Palæont. Bull., No. 1, 1872, p. 463; Proc. Amer. Philos. Soc., xii, 1873, p. 463.
Emys polycyphus, Cope, Sixth Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 625, 629.
Emys polycypha, Cope, Vert. Tert. Form. West, 1884, pp. 129, 131, plate xviii, figs. 20–22.

The type of the present species is in the U. S. National Museum and bears the catalog number 4097. The species was based on very meager materials and only a portion of this was figured. The remains were found in the Bridger beds, but the exact locality and level were not communicated.

The following is Cope's description:

> This species of tortoise is indicated by vertebral, costal, and marginal bones of very small individuals. These bones are, however, not only thoroughly ossified, but are very stout, indicating the adult age of the animal. The deeply impressed scutal sutures, and heavy proportions, as well as the elevated carina of the carapace, indicate affinity with *Cistudo*, or, perhaps, *Testudo*. As a generic character, it may be noted that the vertebral bones are subquadrate, and support the neural canal without intervening lamina.
>
> The carina of the carapace is abruptly interrupted at intervals; sometimes with, sometimes without, a pair of pits, one on each side. The marginal bones are well secured and the scutal sutures are deeply impressed on them.
>
> *Measurements.*
>
> | | *Meter.* |
> |---|---|
> | Length of vertebral bone | 0.009 |
> | Width of vertebral bone | .0085 |
> | Length of marginal bone | .01 |
>
> This is the least of the tortoises of the Bridger formation.

The measurements given above of the neural (vertebral bone) apply to neither of those figured by Cope. The original of his fig. 20 represents a neural 8 mm. long and 8 mm. wide.

The figure itself is incorrect. His fig. 21 is that of a bone 7 mm. long and 8 mm. wide. The bones figured indicate a turtle which had a carapace about 100 mm. long. The originals of Cope's figs. 20, 21, and 22 are in the U. S. National Museum. We are not informed by that writer whether or not these bones belonged to a single individual. If they do, his fig. 21 represents the seventh neural and his figure 20 the eighth. Cope's fig. 22 represents a peripheral. In its upper border there is a pit for the end of a rib. The fore-and-aft extent of the bone is 9 mm. Its free border is broken away, but the height of the bone was somewhat more than 10 mm. It is considerably recurved. Its thickness is between 3 mm. and 4 mm. The sulci crossing it are broad and rather deeply impressed.

Palæotheca terrestris Cope.

Palæotheca terrestris, COPE, Palæont. Bull. No. 1, 1872, p. 464; Proc. Amer. Philos. Soc., XII, 1873, p. 464.
Emys terrestris, COPE, Sixth Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), pp. 625, 629; Vert. Tert. Form. West, 1884, pp. 129, 130, 131, plate xviii, figs. 23–25.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

Of Cope's specimens of this species, three in number, those parts represented by his figs. 23, 24, and 25 of the plate cited are in the U. S. National Museum and have the number 2107. All his materials were found in Bridger strata, but the exact locality and level are nowhere mentioned. They were undoubtedly secured somewhere in the region about Fort Bridger, Wyoming.

Of his type specimen Cope figured 1 neural, 1 costal, and the right epiplastron. In his description he probably intended to give the measurements of the neural figured. At any rate, there is some error, for it is not probable that any neural was twice as wide as long. The neural figured is 9 mm. long and 13 mm. wide. The width of the costal is given as 11 mm., whereas the width of his figure 25 is only a little more than 10 mm.

This species is stated by Cope to differ from *P. polycypha* in having bones at once larger and thinner; and this is confirmed by a comparison of the neurals of the two species, as they are figured. As in the case of *P. polycypha*, there was a dorsal carina, and this was interrupted by the deeply impressed scutal sulci which crost it.

The epiplastron is 19.5 mm. long and 18 mm. wide. The lip projected abruptly from the general outline about 3 mm. and was truncated. The anterior edge was acute. At its base the lip was 21 mm. wide and nearly as wide in front, the width of the half of it present being 10 mm. On the upper side of the lip the bone was thickened backward for a distance of about 11 mm., the greatest thickness being 4.5 mm.

Cope's fig. 25*b* gives a view of the hinder articular border of a costal. This is 3 mm. thick at the proximal end of the bone, but at the lower end is 5 mm. This costal appears to be the fifth of the right side; and with the succeeding one formed a ridge for the inguinal buttress. As shown by Cope's fig. 25*a*, at the lower end of the bone and at its hinder border there was the half of an excavation for this buttress. About the distal half of the costal is broken away and the buttress therefore ascended one-half the height of the costal. The rib-head is hardly discernible. The proximal end of the costal does not join accurately the neural of Cope's fig. 23; hence it is concluded that this neural is the third. The costo-vertebral sulcus (Cope's fig. 25) crosses the costal at a distance of 5 mm. from the proximal end, from which fact it is concluded that the fourth vertebral scute was about 28 mm. wide. The turtle was undoubtedly a small one with a thick, heavy shell.

Cope states that the articulations of the bridge with the costals were not known to him.

No specimens belonging to this species or to *P. polycypha* were secured by the expedition from the American Museum of Natural History into the Bridger beds in 1903.

Genus HYBEMYS Leidy.

Insufficiently known emydoid turtles, the upper surface of whose peripherals was ornamented by a row of hemispherical bosses, each of which was crost by the suture between the two peripherals on which it rested.

Type: *Hybemys arenaria* Leidy.

Hybemys arenaria Leidy.

Hybemys arenarius, LEIDY, Proc. Acad. Nat. Sci. Phila. 1871, p. 103; Fifth Ann. Report U. S. Geol. Surv. Montana, etc., 1871, (1872), p. 369; Contrib. Ext. Vert. Fauna West. Terrs., 1873, p. 174, plate xv, fig. 9.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

This species was based by Dr. Leidy on a single peripheral and a fragment of a costal of an emydoid turtle believed to be about the size of *Chrysemys picta* or *Clemmys guttata*. These bones were secured on Little Sandy Creek, Wyoming. The level is that known as horizon A of the Bridger Eocene. The specimen belongs to the Academy of Natural Sciences, Philadelphia.

The bones are described as being unusually thick in proportion to the width. The sulci are strongly markt. The rib-heads are stout. The outer portion of the upper surface of the peripheral is strongly defined by the groove of the costo-marginal sulcus. At the anterior and the posterior ends of the peripheral there is seen a semicircular boss. It is inferred that the other peripherals had at each end a similar semicircular boss, so that around the carapace, on the peripherals, there was a row of hemispherical elevations, each of which was crost by the suture between the two peripherals on which it rested.

Genus CHRYSEMYS Gray.

Shell smooth, deprest, without traces of dorsal keel. Carapace not serrated behind; often dentated in front. Plastron with broad anterior and posterior lobes. The anterior lobe with a distinct lip which is often dentated. Posterior lobe truncated behind, scarcely notcht. Inguinal buttresses articulating with the fifth costals. Alveolar surfaces of the upper jaw narrow in front, increasing in width backward, never very broad, and with a feeble longitudinal ridge. Choanæ on line joining the fronts of orbits. Alveolar surface of lower jaw with a longitudinal groove bounded inwardly by a sharp ridge. Symphysis of lower jaw very short.

The type of this genus is *Chrysemys picta*, the painted turtle of the Atlantic states of the Union. From the Alleghenies to the Mississippi River the genus is represented by *C. cinerea*. West of the Mississippi river we find *C. belli;* while in the lower region of that great stream is found another species or race, *C. dorsalis*.

To the writer it appears that these species form a natural group worthy of generic rank, and that *C. timida* is an extinct member of that group.

Chrysemys timida sp. nov.

Plate 46, fig. 2; text-fig. 449.

Chrysemys timida is founded on a shell which belongs to the E. & M. Museum of Princeton University, and has the catalog number 10853. It was collected by the University expedition, in the Equus beds of Sheridan County, Nebraska, not far from the Niobrara River. Doubtless, as it lay in the matrix it was complete; but from the vicissitudes of collecting, transporting and preparing, it has suffered somewhat. The matrix is sand that scarcely coheres and the bone itself is friable. In its present condition most of the peripherals of the left side are gone and considerable portions of those of the right side. The other parts of the carapace are in good condition and display well the bone sutures and the sulci. Portions of the plastron have crumbled away, but the structure can be pretty satisfactorily determined.

Dimensions of neurals.			Dimensions of vertebrals.			
No.	Length.	Width.	No.	Length.	Width in front.	Greatest width.
1	16	10	1	30	45	45
2	14	12	2	28	26	46
3	14	14	3	29	34	48
4	14	14	4	32	32	42
5	13	13	5	27	20	42
6	11	12				
7	10	8				
8	13	6				

The individuals of this species reacht a considerable size, compared with those now living, being about equal to *C. belli*. The extreme length of the carapace (plate 46, fig. 2; text-fig. 449) was perhaps a little more than 160 mm.; the breadth, about 120 mm. The shell was evidently

considerably deprest, but probably less so than its present height, 40 mm., indicates. We can not determine to what extent, if any, the hinder border of the carapace was notcht. The hinder peripherals are slightly recurved. Their free margins are acute. No carina is present, but on the nuchal and the first neural there is a perceptible elevation. In the region of the hinder neurals there is a decided longitudinal depression. The surface is smooth, except that on the outer ends of the costals there are longitudinal ridges and grooves, due to the growth of the epidermal scutes.

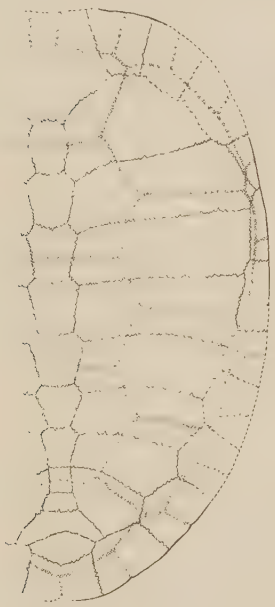


FIG. 449.—*Chrysemys timida*. Carapace. $\times\frac{1}{2}$.

The neural bones are rather narrow in comparison with those of *C. picta*. Most of them are hexagonal, with the broader end forward. The dimensions of the neurals are shown in the table on page 345.

The nuchal had a median length of more than 30 mm., a marginal width of about 20 mm., and an extreme width of 35 mm. The suprapygal plates are three in number. The first has a length of 5.5 mm. and a width of 10 mm. The second is bifurcate, like the same bone in *Testudo*, the hinder border being deeply concave. The median length is 7 mm., the extreme width, 21 mm. The third is nearly diamond-shaped, fitting in between the second suprapygal and the pygal. It is 8 mm. long and 15 mm. wide. The pygal is 22 mm. wide, 17 mm. long and 4.5 mm. thick.

The first peripheral is 20 mm. fore and aft and the same along the free margin. The eleventh is 18 mm. high and 17 mm. along the free margin.

The plastron is somewhat damaged. It is 157 mm. long. The anterior lobe is 43 mm. long and 72 mm. wide at the base. The lip is truncated and appears to have been 40 mm. wide. The hinder lobe is 55 mm. long and 84 mm. wide at the base. A broad notch occupied the hinder end. The inguinal buttress is attacht to the fifth costal plate.

The entoplastron is 25 mm. long and 27 mm. wide. The hypoxiphiplastral suture appears to have run nearly straight across the hinder plastral lobe.

The hyoplastrals occupy about 36 mm. of the midline; the hypoplastrals, about 48 mm.; the xiphiplastrals, about 37 mm.

The vertebral scutes are rather broad and are strongly bracket-shaped laterally. Their dimensions are given in tabular form on the preceding page.

The inferior surface of the plastron is injured so that few of the sulci can be traced. The abdomino-femoral passes between the inguinal notches with a slight convexity forward. The femoro-anal sulcus is directed outward and backward. The femoral scutes are about 18 mm. long on the midline; the anals, about 30 mm.

Genus DEIROCHELYS Agassiz.

Differs from *Chrysemys* in having the heads of the ribs long and thread-like, and the shell sculptured.

Type: *Deirochelys reticulata* (Daudin).

The following species is referred provisionally to *Deirochelys*.

Deirochelys floridana sp. nov.

Plate 54, figs. 1, 2; text-fig. 450.

The nuchal bone on which the present species is based is a part of the Jarman collection, the property of the Vanderbilt University, Nashville, Tennessee. The collection was obtained in Hillsboro County, Florida, and the deposits probably belong to the Peace Creek beds. While the generic position of the species is not assured, the form of the bone and especially its sculpture so much resemble that of *Deirochelys reticulata* that it is referred to the latter interesting genus.

The nuchal bone here described has a median length of 70 mm. The anterior border has a width of 37 mm. The extent between the lateral angles is 77 mm. The hinder border measures 17 mm. The anterior border is acute. From this the bone thickens backward on the under side for a distance of 40 mm. Here the thickness is 20 mm. On the midline the greatest thickness is 17 mm. The excavation for the first neural is narrow and the bone is here 6 mm. thick.

The nuchal scute is 32 mm. long, 5 mm. wide in front, 17 mm. wide behind. The fore-and-aft extent of the first marginals is 41 mm. The front of the first vertebral scute is 51 mm. wide. Backward it narrows slightly, then again expands. It extends backward on the bone a distance of 38 mm. The lateral angles are occupied by portions of the first costal scutes.

The sculpture consists of more or less continuous ridges of quite uniform height, separated by sharp grooves. Usually there are 5 or 6 of these ridges in a line 10 mm. long. On the nuchal scute area these ridges are parallel with the midline. On the area of the first marginal they run outward and forward, making an angle of about 25° with the midline. On the area covered by the first vertebral scute the ridges are nearly parallel with the midline, those along the lateral borders of the scute diverging somewhat. The ridges of the areas of the costal scutes are the most prominent, and they make an angle of about 45 degrees with the midline.

Specifically this species is very different from *D. reticulata*. In the latter the first vertebral scute excludes wholly the costal scutes from the nuchal bone. This bone is far thinner than in *D. floridana*.

No other bones in the collection can be referred with certainty to this species. In the collection there is the front two-thirds of the right first costal plate of a turtle that is provisionally placed here (plate 54, fig. 2; text-fig. 450). It fits quite accurately against the postero-lateral border of the type bone and agrees with it in sculpture and thickness. Furthermore, the costo-vertebral sulcus coincides with that of the nuchal. The distal end of the bone is thickened and on the inner surface excavated for the axillary buttress.

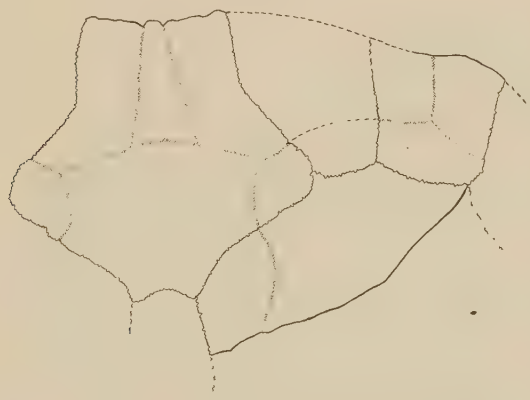


FIG. 450.—*Deirochelys floridana*. Nuchal, first and second peripherals, and part of first costal. ×½. Partly restored.

A peripheral, the right second, may belong to this species. Fig. 450 represents the type nuchal, the first costal mentioned above, and this peripheral, placed in their proper positions with reference to one another. The height of the peripheral is only 34 mm.; but when we examine the same bone in *D. reticulata* we find that it too is reduced in the line from the free border to the upper border. This is a result of the narrowing of the carapace. The first costal scute descends on the bone a distance of 26 mm. The sculpture on its area is directed downward. On the area of the second marginal scute the ridges run at nearly right angles with the free border. On the area of the succeeding scute they are directed downward and strongly backward.

In the Jarman collection is the portion of a left xiphiplastron extending backward from the femoro-anal sulcus. The lower surface is ridged and grooved like the type nuchal, the ridges being directed parallel with the midline. The hinder border of the plastron was slightly notcht, as in *D. reticulata*. At the midline the bone is from 5 mm. to 7 mm. thick. The plastron had a length of about 290 mm. The bone greatly resembles the corresponding part of *D. reticulata*.

Genus TRACHEMYS Agassiz.

Shell varying from deprest to rather elevated. Usually at least traces of a dorsal keel. Neural plates hexagonal, with broad end in front. Carapace sometimes smooth, but more usually with wrinkles and grooves; occasionally elaborately sculptured. Hinder border of carapace usually more or less serrated. Plastron with a distinct lip in front and a shallow

emargination behind. Alveolar surfaces of upper jaw each with a longitudinal ridge, which is somewhat denticulated and higher behind than in front. Choanæ nearly as far back as a line joining the middles of the orbits. Alveolar surface of the lower jaw with a longitudinal groove, which is separated from a shallower groove by a longitudinal ridge. Symphysis of lower jaw short, equal to about half of the distance between the quadrates.

As type of this genus may be taken *T. scripta*, the species longest and best known and incidentally the one mentioned first by Agassiz under the name.

The species of this genus are allied to the species of *Chrysemys*, but they attain a larger size, possess a more vigorous organization, and a fiercer disposition. The wrinkled and furrowed carapace, notcht posteriorly, distinguishes the species from those of *Chrysemys*. The plastron has a quite distinct lip, and this is occasionally slightly dentated, but not so conspicuously as in *Chrysemys*.

The following analysis may aid in determining species of which the nuchal bone is present:

1. All the bones thin and little sculptured	*hilli*
2. Nuchal thick, strongly sculptured; free border broader than in *T. sculpta*, with notch for neural broader	*euglypha*
3. Nuchal not so thick as in *euglypha*, about 15 mm.; free border rather obtuse	*sculpta*
4. Notch for first neural extremely broad	*jarmani*
5. Nuchal moderately thick, 10 mm.; width in front half the maximum width	*petrolei*
6. Nuchal bone moderately thick; width in front three-fifths the maximum	*bisornata*
7. Epiplastral lip spout-like	*trulla*

Trachemys hilli (Cope).

Plate 55, figs. 1, 2; text-figs. 451, 452.

Pseudemys hillii, Cope, Bull. Geol. and Geog. Surv. Terrs., iv, 1878, p. 395.
Trachemys hillii, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 449.

At the present time this species is represented by only the type specimen. This is in the American Museum, as a part of the Cope collection of reptiles, and has catalog number 2425. It was collected for Professor Cope in 1877, by Mr. R. S. Hill, in Decatur County, Kansas, from Loup Fork deposits. It came, therefore, from the same locality and the same level as the specimens of *Testudo orthopygia*. Since its arrival at the American Museum the fragments of which the specimen was composed have been articulated under the supervision of the writer; and the present appearance of the specimen is shown on plate 55. The shell has retained the plastron complete, except that the entoplastron and the epiplastra are missing. Of the carapace (plate 55, fig. 1; text-fig. 451) the peripherals are present from the rear to the fourth inclusive on the right side and to the fifth inclusive on the left side. The third left peripheral also is present. The nuchal is wanting. Only 3 complete neurals have been preserved, the fourth, the fifth, and the seventh. A portion of the third is at hand. On the right side we have the first, second, and fourth costals, and the proximal end of the third. On the left side there are present the third, the fifth, and sixth costals, with a portion of the eighth. Both suprapygals are wanting.

The whole length of the shell was very close to 200 mm. The width at the hyohypoplastral suture is 138 mm. The width of a specimen of *T. rugosa*, from some of the West Indian islands, whose length of carapace is 192 mm., is 147 mm. It will be seen therefore that the Loup Fork species is relatively more elongate.

In elevation of shell this species resembles *T. elegans* or *T. rugosa*, rather than *T. scripta*, the carapace being rather deprest. The maximum height from the bottom of the shell is 75 mm.

The fourth neural has a length of 17 mm. and a maximum width equal to the length. The fifth neural is 18 mm. long and 16.5 mm. wide. The sixth neural had a length of 15 mm. and a maximum width of 16 mm. The second pygal was 27 mm. wide.

Over the bridges a sharp keel intervened between the upper and the lower portions of the shell. The free border of the third peripheral is acute. The posterior peripherals are only slightly flared upward. Their free borders are thin and brought down to an acute edge. The

height of the eleventh is 29 mm.; its width along the free border, 22 mm. The pygal has a height (antero-posterior dimension) of 23 mm. and a width of 21 mm. It has a deep median notch; and there is a similar notch on each side of it. The interperipheral notches are not deep, and there are no notches where the sulci cross the borders of the peripherals. In the latter respect this species differs from *T. elegans*.

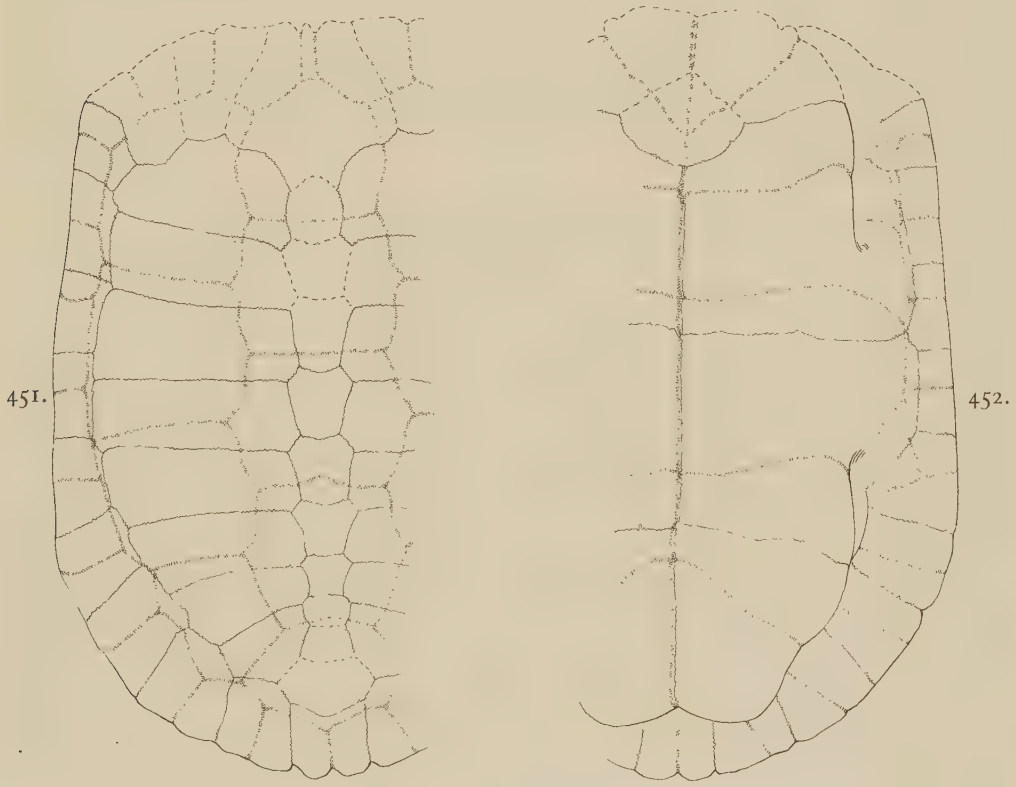
Vertebral scute.	Length.	Width.
1	..	33
2	35	44
3	35	47
4	37	40
5	32	47

The bones of the carapace are thin, the border of the median costals being but little more than 2 mm. thick.

The sulci are rather deeply imprest on the carapace. The form and dimensions of the various scutes may be readily determined from fig. 451. The table herewith gives the dimensions of the vertebrals.

The arrangement and forms of the scutes closely resemble those of the specimen of *T. rugosa* already mentioned.

The sulci separating the costal from the marginal scutes are arranged somewhat differently in this species from the arrangement in *T. rugosa* and *T. scripta*. In *T. rugosa* the costo-mar-



FIGS. 451 AND 452.—*Trachemys hilli*. Carapace and plastron of type. $\times\frac{1}{2}$.

451. Carapace. Front restored. 452. Plastron. Anterior lobe partly restored.

ginal sulci run along on the peripherals at a considerable distance below the costo-peripheral sutures from the nuchal to the eleventh peripheral. Here the sulcus rises somewhat and crosses the midline on the hinder border of the suprapygal. In *T. scripta* the arrangement is the same to the eleventh peripheral, where it remains low down and crosses the upper third of the pygal. In *T. hilli* from the front of the bridge the sulci appear to coincide closely with the sutures until the seventh peripheral is reacht. Here the sulci descend on the peripherals, but not far, and they cross the midline on the upper part of the pygal.

In the case of the neurals preserved there are some longitudinal wrinkles on the hinder ends of the third and the fifth, just behind the sulci crossing these bones. On the costals is a

number of longitudinal grooves, which mark the growth of the scutes. The deepest ones are from 5 to 7 mm. apart and appear to indicate the yearly increase in size. On each peripheral behind the bridge we find in front of the sulcus crossing it some strong grooves parallel with the free border of the shell; behind the sulcus, some more delicate grooves more nearly parallel with the axis of the shell.

The length of the plastron (plate 55, fig. 2; text-fig. 452), from the outer anterior angle of the epiplastron to the extremity of the xiphiplastron, is 165 mm. In the midline, from the hinder border of the entoplastron to the notch in the rear, the length is 142 mm. The width of the anterior lobe at the base is 91 mm. The entoplastron had a width of 33 mm.

The bridge has a width of 69 mm. It rises rapidly from the bottom of the plastron.

The hinder plastral lobe has a length of 75 mm. and a width of 90 mm. at the base. Near the suture between the hypoplastra and the xiphiplastra the width is 96 mm. At the end of the femoro-anal sulcus there is only a slight notch. The free margins of the plastral lobes, so far as preserved, are acute. The extremities of the xiphiplastral bones are rounded and slightly dentated.

The humero-pectoral sulcus crosses the plastron behind the entoplastron. The pectoral scutes have a width at the midline of 27 mm.; the abdominals, a width of 22 mm.; the anals, a width of 40 mm. There are large axillary and inguinal scutes.

The lower surface of the plastron is delicately grooved longitudinally.

Professor Cope mentions the presence of portions of the skull; but there is little more than the left quadrate. It presents no difference when compared with that of *T. rugosa*.

The shoulder-girdle and the limb bones appear to resemble essentially those of the living species just mentioned.

Trachemys euglypha (Leidy).

Plate 54, fig. 3.

Emys euglypha, Leidy, Proc. Acad. Nat. Sci. Phila. 1889, p. 97; Trans. Wagner Free Instit., II, 1889, p. 27, plate iv, fig. 1.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 447.

The present species was based on a single bone, the nuchal, of a turtle found in the Peace Creek beds, Florida. Dr. W. H. Dall, of the U. S. Geological Survey, has examined these deposits and pronounct that bed, about 2 feet in thickness, from which vertebrate remains have been obtained, to be of older Pliocene age. However, since from that bed Dr. Leidy has described vertebrates belonging to various epochs, from the Miocene to the present, the correctness of the determination is in question. The type of the species here described belongs to the Wagner Free Institute, Philadelphia, but the writer has not been able to find it there.

Dr. Leidy has referred his species to the genus *Emys*; but it can not belong there—as that genus is understood at present. The nuchal resembles closely that of a specimen of *Trachemys scripta* now in the American Museum of Natural History. From this, however, it differs specifically. The length of the bone at the midline is 58 mm. The total length of the carapace of the specimen of *T. scripta* just mentioned, the length of whose nuchal is 50 mm., is 210 mm. We may therefore conclude that the carapace of Dr. Leidy's type had a length of about 290 mm. The width of the front of the nuchal is 37 mm., the greatest width 73 mm. This border is deeply notcht, but the bottom of the notch is divided by the projection into it of the area occupied by the nuchal scute, which is 11 mm. wide. The thickness of the bone at the articulation with the first peripheral is 21 mm.; at the articulation with the first neural, 6 mm. The nuchal of the specimen of *T. scripta* mentioned has a maximum thickness of only 10 mm. a fact showing that *T. euglypha* had a shell much thicker and heavier than that of the living species. The width of the border which articulated with the first neural is 23.5 mm.

The scutal sulci are deeply imprest. The nuchal scute has a length of 20 mm. and a width of 10 mm., its lateral borders being parallel. That part of the first vertebral scute which lies on the nuchal bone is 38 mm. long. Measured anteriorly between the points where the lateral sulci of the vertebral join the costo-marginal scutes, the width of the first vertebral is 34 mm. Measured posteriorly, where the lateral sulci pass on to the first costals, the width is 50 mm.

The upper surface of this bone is strongly sculptured, resembling somewhat that of *T. scripta*, but ridged and grooved more boldly.

The writer has received for examination from the Wagner Free Institute an injured nuchal bone (plate 54, fig. 3) that was collected at Peace Creek, Florida. It has some resemblance to that of *T. euglypha*. The sculpture is not so strong and that produced by the growth of the horny scutes shows in addition to that seen in the type of the species. On the area of the first vertebral scute, in the midline, there is a high ridge, or carina.

Trachemys sculpta sp. nov.

Plate 54, figs. 4–9.

In the Dr. Jarman collection of fossil bones made in Hillsboro County, Florida, now the property of Vanderbilt University, there is a strongly sculptured nuchal bone which represents probably a hitherto undescribed species. This nuchal resembles much that of *T. bisornata* (Cope) and possibly belongs to it; but the differences in form and sculpture and apparently the differences of level seem to justify regarding it as distinct. Cope's *bisornata* came from the Equus beds, belonging to the Pleistocene; the present species from probably the Peace Creek beds, belonging to the Pliocene.

The nuchal (plate 54, fig. 4) has a median length of 55 mm.; a width of 29 mm. in front; and a maximum width of 63 mm. The length and breadth are relatively the same as in *T. bisornata.* The width in front is only 50 per cent. of the length, while in *T. bisornata* it is 70 per cent. The anterior edge is obtuse; in the Texas species it is acute. The greatest thickness, just behind the sulcus between the nuchal and vertebral scutes, is 15 mm.; that at the articulation with the first peripheral, 13 mm. Where the bone joins the first neural the thickness is 7 mm. The area of the first vertebral scute is very convex, producing a broad rounded carina.

The sulci are sunken to a great depth. The nuchal scute is long and narrow, and its area is raised into a strong ridge. The first vertebral is 24 mm. wide in front and it expands posteriorly. The front of each first marginal on this bone is nearly one-half the width of the front of the first vertebral. In *T. bisornata* it is not one-third. The areas of the first marginals are sculptured into prominent ridges and grooves. In *T. bisornata* these are feeble and the lines of growth of the scutes are more prominent. Where the ridges show in *bisornata* they diverge at a greater angle from the midline. On the area occupied by the first vertebral of *T. sculpta* there are some ridges running parallel with the midline. On the area occupied by each first marginal there are 5 or 6 ridges which run outward and backward.

Plate 54, fig. 5, represents the distal end of probably the third costal. Its width is 45 mm. at the distal border, but it narrows upward. The fragment belongs to the Jarman collection, in Vanderbilt University.

Plate 54, figs. 6, 7, represents two neural bones found with others of the same kind in the Jarman collection. The one with the sulcus crossing it has a length of 35 mm. and a thickness where it joined the costal of 15 mm. They may or may not belong to the species here described.

Figs. 8 and 9 of plate 54 represent two costals which may belong to the present species. Fig. 8 is probably the right fourth costal and lacks the proximal half. The thickness at the distal end is 8 mm. The original of fig. 9 is the left sixth costal. It is thickened on the anterior border of the distal end to 13 mm., the posterior border at the distal end being only 9 mm.

The type nuchal resembles rather closely *T. euglypha* (Leidy); but the front of the nuchal of the latter is broader and more deeply notcht and the excavation for the first neural is broader. The nuchal scute is broader and shorter. The greatest thickness is 21 mm., far exceeding that of *T. sculpta.*

Trachemys? jarmani sp. nov.

Plate 54, figs. 10–12.

The species to which the above name is given is based on a complete nuchal bone, a part of the Jarman collection of fossil bones obtained in Hillsboro County, Florida, by Dr. W. H. Jarman, and presented by him to Vanderbilt University, Nashville, Tennessee. The age of the beds is somewhat uncertain, but they are probably of the same age as the Peace Creek beds. The species is referred provisionally to *Trachemys.*

The nuchal (plate 54, fig. 10) is remarkable on account of the shortness of its hinder portion and the evidence which it affords that the neural bones were very broad. The total

length of the bone is 61 mm. The front border is excavated slightly; the hinder border widely, for the reception of the first neural. The length along the midline is 47 mm. The width of the anterior border is 37 mm.; the greatest width, 80 mm. The anterior border is acute. From this the bone thickens backward on the under side a distance of 47 mm., where, at the midline, it is 20 mm., at the border for first peripheral, 25 mm.; then it thins rapidly to the hinder border, where it is 13 mm. at the midline, 10 mm. at the sides of the notch for first neural.

In this species the front of the first neural is on a line with the lateral angles of the bone, an unusually forward position. The neural must have been of uncommon width, not less than 50 mm., occupying thus five-eighths of the width of the nuchal. This first neural must, too, have been 13 mm. thick in front.

The nuchal scute is 34 mm. long, 6 mm. wide in front, 12 mm. wide posteriorly. On the inner side of the bone it extended backward 21 mm. The first marginal had an extreme fore-and-aft extent of 40 mm. The front of the first vertebral scute is 41 mm. wide. It extended forward on the nuchal only 13 mm. at the midline. The lateral angles of the bone are occupied by portions of the first costal scutes.

The upper surface of the bone is beautifully sculptured with grooves and sharp, interrupted ridges. On the nuchal scute area the ridges run parallel with the midline. On the areas of the first marginal scutes the ridges are short and suddenly interrupted at their anterior ends. They run forward and outward, making an angle of about 25° with the midline. The ridges on the front of the first vertebral scute area are short, almost tubercular, and are parallel with the midline. On the areas of the first costal scutes the ridges are coarser and they run outward and backward, making an angle of 64° with the midline.

No other parts are known that can be referred with certainty to this species. No neurals in the collection are broad enough to belong to it. A peripheral (plate 54, fig. 11), the right eighth, appears to be worthy of reference here on account of its sculpture and thickness. It has a height of 50 mm., a width of 39 mm. below, and of 33 mm. above. The free border is acute. From this the bone thickens rapidly, so that near the middle of the height it is 26 mm. where it joined the sixth peripheral; 19 mm. where it articulated with the ninth. On the inside of the bone, at the upper posterior angle, is a pit for the end of a rib, probably the sixth. On the articular face for union with the fifth peripheral there is a striated depression, which appears to have been a part of a pit between the two peripherals for a rib, the fifth. On the same face, nearer the inner surface of the bone, is a rounded smooth depression which indicates that the sternal chamber reacht this face. Still nearer the inner surface of the bone is an excavation apparently for a part of the inguinal buttress.

The sculpture of this bone resembles that of the nuchal of *Deirochelys floridana*. However, the thickness appears to be too great for the latter species.

A left third costal in the collection is referred provisionally to this species (plate 54, fig. 12). It presents the proximal end. The width, just outside the costo-vertebral sulcus, is 38 mm. It belonged to an individual with a carapace about 340 mm. long. The most conspicuous character is the great thickness at the suture with the neurals, this being 20 mm. The thickness diminishes to the costo-vertebral sulcus where it is 9 mm. The thickening has produced a broad keel along the back. The sculpture agrees well with that of the type nuchal bone.

Trachemys petrolei (Leidy).

Plate 46, figs. 3, 4.

Emys petrolei, Leidy, Proc. Acad. Nat. Sci. Phila. 1868, p. 176; Contrib. Ext. Vert. Fauna West. Terrs., 1873, pp. 260, 340, plate ix, fig. 7.—Cope, Ext. Bat., Rept., and Aves N. A., 1869, p. 128.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.

Dr. Joseph Leidy states in his original description of this species that the types had been submitted to him for examination by Messrs. George N. Lawrence and D. G. Elliot, of New York, and that they had been previously presented to the New York Lyceum of Natural History by Mr. Robertson. The specimens were reported to have been obtained from blue clay and sand beneath a bed of bitumen, in Hardin County, Texas. The age is Pleistocene. These bones and most of those accompanying them are impregnated with bitumen. They now belong to the American Museum of Natural History and have the catalog number 3933.

The type of the species *Emys petrolei* Leidy must be regarded as being the two epiplastrals figured by him in 1873. Leidy mentions and briefly describes a nuchal bone and a hypoplastral, but there is no certainty that these belonged to a member of the same species. The two epiplastrals are the right and the left, but they did not belong to the same individual. Dr. Leidy's figures present a view of the lower surfaces; the figures here presented (plate 46, fig. 3) represent the upper surfaces.

The individuals to which these epiplastrals belonged appear to have had plastra about 200 mm. long, tho perhaps somewhat less. Dr. Leidy thought that the animal belonged to the genus *Trachemys* and compared it especially with *T. scripta* (*T. scabra*). When compared with a specimen of the latter whose plastron is 270 mm. long there appear decided differences.

The epiplastral lip of *T. petrolei* was 52 mm. wide; that of the specimen of *T. scripta* referred to is 60 mm. wide, a difference due to difference of size of the individuals. The lip of *T. petrolei* is directed forward; that of *T. scripta* is rolled downward in front. The thickness of the epiplastrals of *T. petrolei* at the symphysis is 11.5 mm., somewhat more than that of the specimen of *T. scripta*, altho the latter is so much larger. The backward extension of the lip, along the midline on the upper surface, is 29 mm. in *T. petrolei;* in *T. scripta*, only 23 mm. In the former the thickening referred to ends posteriorly much more abruptly than it does in *T. scripta*. In both species it may be observed that the gular scutes overlapt the anterior ends of the entoplastron. There can be no doubt that *T. petrolei* is a species distinct from both *T. scripta* and *T. elegans*. The latter species occupies at present the region where *T. petrolei* was found. *T. elegans* has a very different epiplastral lip, this being wider; concave above so as to resemble a spout; and not so thick. In both *T. scripta* and *T. elegans* the gular sulci on the upper surface of the epiplastrals run outward and forward, while in *T. petrolei* they run directly forward.

It will be observed from the figures that there are some differences between the two epiplastra, but these are not sufficient to indicate distinct species.

The nuchal bone (plate 46, fig. 4) mentioned by Dr. Leidy has a length of 46 mm. and a maximum breadth of 50 mm. The width at the free border has been 25 mm. The border for articulation with the first peripheral is very concave. Where the sulci bounding the nuchal scute crost the free border there are very deep notches, so that the nuchal scute projects as a prominent tooth. The greatest thickness of the nuchal bone is 10 mm.

The nuchal scute is 20 mm. long and 7 mm. wide at the base. The width of the scute on the under side of the bone is slightly less. In *T. scripta* the scute is nearly twice as wide on the lower side as on the upper. In *T. elegans* the lower side is about one-half wider than the upper. The first vertebral scute of *T. petrolei* has a width anteriorly of 27 mm., and it has grown wider posteriorly. In the specimen of *T. scripta* mentioned, the first vertebral is only 18 mm. wide anteriorly. In the midline of the fossil nuchal there is a mere suggestion of the presence of a carina; in *T. scripta* the carina is very distinct. As to the sculpture, there are faint ridges which occupy the same positions as the much more distinct ones in *T. scripta* and *T. elegans*.

The hypoplastral bone mentioned by Dr. Leidy is present, as well as a second belonging to another individual. These are much thicker than the corresponding bones of *T. elegans* and somewhat thicker than those of *T. scripta*. Here again we are uncertain whether these bones belong to the same species as the epiplastra.

The nuchal bone above described resembles that of the species described by Cope under the name *Pseudemys bisornatus*, here called *Trachemys bisornata*. We must therefore consider the possibility that Cope's species is identical with that described earlier by Leidy. This question can not be settled until additional materials have been collected at one or both of the localities, Hardin County and Atascosa County.

Trachemys bisornata (Cope).

Plate 56, fig. 1.

Pseudemys bisornatus, Cope, Proc. Amer. Philos. Soc., xvii, 1878, p. 228.
Trachemys bisornata, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 449.

This species is stated to be based on portions of 3 individuals, which were collected for Professor Cope by Mr. G. W. Marnock, in southwestern Texas. The beds are stated to belong to the Pliocene; but now they are regarded as Pleistocene.

In the collection of the Philadelphia Academy there is found a part of the anterior half of a carapace which evidently belongs to this species and which is probably one of the three portions referred to by Cope in his description. It is labeled in Cope's handwriting, and is stated to have been collected by G .W. Marnock, from the Pliocene beds of Atascosa County, Texas. *Terrapene marnochii* was described by Cope on the page following the description of the present species and was said to come from the same formation. From the American Naturalist, vol. XXIII, 1889, page 161, we learn that the latter-named species was found in the Equus beds. From these Equus beds we have therefore *Testudo atascosæ* Hay, *Terrapene marnochii* (Cope), *Trachemys bisornata* (Cope) and *T. trulla* Hay.

The specimen (plate 56, fig.1) in the Philadelphia Academy consists of the nuchal, the first right peripheral, the first and second right costals, parts of the third and fourth right costals, the first, second, fourth, and fifth neurals, and the proximal portions of the first and second left costals. The third neural is missing, but its dimensions and form are easily determined.

The nuchal resembles that of *T. scripta*. In front it is thin-edged and sharp. It is slightly notcht at the ends of the sulci bounding the nuchal scute, and between the ends of these sulci are 3 teeth. Its length along the midline is 49 mm.; its width anteriorly, 34 mm.; the maximum width, 55 mm. The table herewith gives the dimensions of the neurals represented.

Neural.	Length.	Width.
1	30	17
2	20	20
3	25	23
4	21	24
5	22	22

The thickness of the fourth neural is 7.5 mm. The first is oval. The second is broadest in front and deeply excavated to receive the first. The other neurals are hexagonal, with the broad end in front.

The second costal is 26 mm. wide near its neural; the third is 28 mm. wide; the fourth, 23 mm. They are rather thick proximally, as is indicated by the thickness of the fourth neural.

The nuchal scute is 19 mm. long and 10 mm. wide posteriorly. The first vertebral is 46 mm. long, 33 mm. wide in front, 40 mm. behind. The second is 52 mm. long and 50 mm. wide. The third is 43 mm. long, 54 mm. wide. The sulci are deeply imprest.

Along the midline there appears a broad and shallow groove, beginning with the first neural, showing most conspicuously on the second, and persisting on the fourth and fifth. There is only a suggestion of a median carina.

The ornamentation of the carapace has been described by Cope, and his description applies to the specimen here considered. The whole surface of the carapace, as far as known, is sculptured into ridges and grooves. The areas occupied by the vertebral scutes are smoothest, but here too we find some sculpture. On those costal bones which are traverst by the intercostal sulci we find that the area in front of the sulcus presents sharp ridges, some of which run at right angles with the sulcus, while others cross these parallel with the sulcus. Behind the sulcus the ridges run only at right angles with the sulcus, and these ridges are broader than those in front of the sulcus. Those costals which are not traverst by the intercostal sulci are ornamented more like the anterior portion of the costal plates first described. The ornamentation may be otherwise described as follows: Along the front of each scutal area there is a band of broad ridges. Most of the remainder of the area is occupied by ridges and grooves running parallel with the length of the animal and crost by a system of less conspicuous ridges. The lower border of the costal scutal area, that formed by the upper borders of the peripheral bones, is occupied by coarse ridges at right angles with the length of the animal.

The sculpture of the carapace of this tortoise has been compared by Cope to that found on *T. elegans*. It appears to be still more like that of a large specimen of *T. scripta* now in the American Museum of Natural History. It can hardly be doubted that the fossil species is closely related to, perhaps the immediate ancestor of, both *T. elegans* and *T. scripta*. It has differed from *T. elegans* in having a considerably thicker and more boldly sculptured carapace; from *T. scripta* apparently in having a less well-defined dorsal carina. Remarks on the possible identity of this species with *Trachemys petrolei* will be found on page 353.

Trachemys trulla sp. nov.

Plate 56, figs. 2–6; text-fig. 453.

The type of this species is No. 3934 of the American Museum of Natural History. It consists of portions of both epiplastra of a specimen which accompanied the type of Dr. Leidy's *Emys* (*Trachemys*) *petrolei;* and was therefore obtained from the Pleistocene deposits of Hardin County, Texas. Without additional materials it is not possible to determine with exactitude the generic relations of the species, but the parts resemble most those of *Trachemys elegans*, a present inhabitant of that region of the country.

The bones forming the type are almost exactly the size of those of a specimen of *T. elegans* whose length of carapace is 240 mm. From the latter it differs in having a much narrower lip, that of *T. elegans* being 59 mm. wide, that of *T. trulla*, 41 mm. wide. The lip of the latter (plate 56, figs. 2, 3) is also of a somewhat different form. In *T. elegans*, seen from above, the gulo-humeral sulci are directed outward and forward to the border of the epiplastral bones, the lip projects rather abruptly, and it is subtruncated. In *T. trulla* each gulo-humeral sulcus, on the upper surface of the bone, runs directly forward, the lip projects gradually from the border of the bone, and rounds forward and inward to the midline. The free border of the lip of *T. elegans* is usually, if not always, dentated; that of *T. trulla* is smooth in outline.

Fig. 453.—*Trachemys trulla.* Plastron restored from bones figured on plate 56.

The lips of both *T. elegans* and of *T. trulla* are excavated on the upper surface so as to resemble somewhat the spout of a pitcher. In *T. trulla* the sides of this spout descend more abruptly than in the case of the observed specimen of *T. elegans*. These sides rise each as a ridge some distance above the level of the gulo-humeral sulcus and parallel with it. Anteriorly each ridge descends into the free border of the lip. At the hinder end of each ridge, at a lower level, is a deep pit.

At the midline on the upper surface the gular scutes extend backward a distance of 15 mm. At the hinder end of the epiplastron the width of the humerals was about 15 mm.

Seen from below, the middle of the lip descends little below the general level of the epiplastral bones. The gulo-humeral sulci are deeply imprest and they extended backward on the entoplastron. The length of the sulcus separating the gulars was 32 mm. The suture between the two epiplastrals has a length of 27 mm. The thickness of the bones at the symphysis is 7 mm. The free border of the epiplastron, where it joins the hyoplastron, is acute; on each side of the gulo-humeral sulcus, thickened and rounded; near the midline, again acute.

With the bone described above are a right hyoplastron, a right hypoplastron, and a left xiphiplastron which are supposed to have belonged to the same species. These bones are represented by figs. 4, 5, and 6 of plate 56.

Text-fig. 453 is a restoration of the plastron, made up from the various bones that are described above.

This figure shows the relative dimensions of the bones and the positions of the scutes. Fig. 4 of the plate cited presents a view of the upper surface of the hyoplastron, fig. 5 of the hypoplastron, and fig. 6 of the xiphiplastron. The relative width of the beveled surfaces on the upper side of these bones is displayed. All the free borders are acute, especially that of the xiphiplastron. The notch at the rear of the hinder lobe was broad, but very shallow. The hyoplastron is 7 mm. thick on the midline, at the middle of the length. The anterior end of the hypoplastron, on the midline, is 7 mm. thick; but further backward becomes 10 mm. The anterior end of the xiphiplastron, at the summit of the bevel, is 7 mm. thick. The bones are not sculptured.

Genus PSEUDEMYS Gray.

Shell in general like that of *Trachemys*. Triturating surface of the upper jaw broad all round, with a strongly developt tuberculated median ridge. Lower jaw with broad surface and a median ridge; its lower surface flat.

Type: *Pseudemys rubriventris* Leconte.

Pseudemys extincta sp. nov.

Plate 54, fig. 13.

The basis of the present species is a nuchal bone belonging to the Jarman collection, the property of Vanderbilt University. The collection was made in Hillsboro County, Florida, from beds belonging probably to the Peace Creek formation.

This nuchal is referred to *Pseudemys* because of its resemblance to that of *P. rubriventris*, of the Southern States. The hinder border is somewhat water-worn, but it evidently follows closely the sutural edge. The median length is 62 mm.; the frontal width, 33 mm.; the maximum width, 70 mm. The anterior border is acute. From this the bone thickens backward about 30 mm., where is becomes 18 mm. at the midline, 15 mm. at the articulation with the first peripheral. Where the bone joins the first neural it is 5 mm. thick. The nuchal scute is 26 mm. long, 9 mm. wide in front, 19 mm. behind. The first vertebral is 48 mm. wide in front, contracting behind this, then again expanding. The first marginal has a length, fore and aft, of 37 mm. Its union with the first costal on this bone is only 10 mm. long.

The upper surface of this bone is in general smooth, but there are traces of a sculpture, produced by the growth of the scutes. On the nuchal area the low ridges run parallel with the midline; so also do those on the area of the first vertebral. Those on the areas of the first marginals run outward and forward at an angle of about 45° with the midline. The ridges on the areas of the first costals run outward and backward at a small angle with the midline.

With the other bones from the region about Tampa Bay there come many portions of plastrons, some of which probably belong to the present species. However, there is no way for connecting any plastral lip, for instance, with any nuchal bone. The writer describes, from that region, a number of species founded on nuchal bones, a quite characteristic part of the skeleton. It remains for collectors and students to find and record other bones in their natural association with these various nuchals.

Pseudemys cælata sp. nov.

Plate 57, figs. 1–6; text-fig. 454.

This name is based on some bones which belong to the U. S. National Museum. They were obtained from "Mason's bone bed," somewhere in Levy County, Florida, and are supposed, but not known, to belong to the Pleistocene epoch. They may belong to the Peace Creek formation. The bones bear the U. S. National Museum's number 2508. They appear to be parts of at least 2 individuals, one considerably larger than the other. Of the larger individual there are present the nuchal; the distal end of the third costal, that of probably the left side; the left fifth costal; the proximal end of the seventh right costal; the third left peripheral; three posterior peripherals; the left epiplastron; and the left hypoplastron. Should it happen that more than one species is here included, the nuchal bone is to be regarded as the type.

This species is conspicuous for its sculpture, which resembles that of *Trachemys scripta*, now living in the Southern States.

The nuchal bone (plate 57, fig. 1) is 45 mm. long and 23 mm. wide in front, and 55 mm. wide where widest. The free border is acute; the greatest thickness, 10 mm.

The third costal is 35 mm. wide distally and nearly 5 mm. thick at the sutural edge. The fifth costal (fig. 2) is 25 mm. wide and 7 mm. thick at the costo-vertebral sulcus, and 32 mm. wide at the distal end. The costo-vertebral sulcus crosses the proximal end at about 10 mm. from the articulation with the neural. On the inner side of the distal half there is a prominent ridge. In the lower end of this ridge is an excavation for the inguinal buttress. This buttress rose about 20 mm. above the lower border of the costal. The seventh costal is 15 mm. wide

at the costo-vertebral sulcus. The third left peripheral (fig. 3) has a length of 32 mm. along the free border, and a height of 30 mm. The extreme width of the face which joins the second peripheral is 20 mm.

Fig. 4 of the plate cited illustrates the tenth left peripheral. It is 21 mm. along the acute free edge, 35 mm. high, and it has a maximum thickness of 7 mm. The upper surface is concave up and down and slightly convex fore and aft. It does not appear to have formed a jagged suture with the contiguous ends of the costals.

The dimensions of some of the scute areas can be only approximately determined. The nuchal scute has a length of 17 mm. and a width of 10 mm. The anterior end of the first vertebral has a width of 37 mm. The anterior end of the fourth vertebral scute overlapt the fifth costal bone a distance of 17 mm. Its width was therefore 34 mm. plus the as yet unknown width of the neural, amounting to probably 45 mm.

The sculpture of the carapace may now be briefly described. On the nuchal bone the area occupied by the first vertebral scute is ornamented with longitudinal ridges, 5 in a line 10 mm. long. These ridges are more or less interrupted by the grooves concentric with the anterior border of the scute. On the area of the first marginal scute the ridges diverge at an angle with the midline and are interrupted by grooves parallel with the midline. The distal half of the third costal is markt by ridges running downward and obliquely toward one edge of the bone. These again are crost by ridges parallel with the distal end of the bone. The fifth costal is similarly sculptured on the distal end, but the ridges are more irregular. The middle third has, along the anterior border, some strong ridges and grooves at right angles with the sutural border, while the hinder half is occupied by conical elevations having little regularity. On the third peripheral bone the area above the costo-marginal sulcus is markt by ridges running downward; the area in front of the intermarginal sulcus shows strong ridges and grooves directed forward; while the area behind this sulcus presents narrower and closer ridges, broken by cross furrows. The hinder peripherals have the area in front of the descending sulcus markt by both vertical and horizontal ridges; while the posterior half presents coarse ridges that run downward and backward.

Fig. 454.—*Pseudemys cælata*. Left half of lower surface of plastral lip of type. $\times\frac{2}{3}$. U. S. N. M.

The plastron possest an anterior lip (fig. 454) whose width was 54 mm. Its free border is subacute. On the upper side of the lip the horn-covered area extends backward a distance of 15 mm. Where the bone joined the entoplastron the thickness is 10 mm. The gular scutes overlapt the entoplastron.

The hypoplastron (plate 57, fig. 5) is 72 mm. long, and it had a width of 55 mm. at the inguinal notch. At the midline, near the anterior end, the bone is 13 mm. thick. The free border of the bone is acute. The horn-covered band on the upper surface is 22 mm. wide at the hypoxiphiplastral suture.

The area occupied by the gular scutes is ornamented with ridges and grooves which are nearly parallel with the gulo-humeral sulcus. The markings on the area of the humeral scute are indistinct. The hypoplastron is distinctly sculptured. On the area of the abdominal scute are short vermicular ridges, reminding one of the carapace of a trionychid. On most of the area of the femoral scutes the sculpture suggests a tiled roof; but on the outer half there are distinct longitudinal ridges, 7 of them in a line 10 mm. long.

Fig. 6 of plate 57 shows the left first costal of a smaller individual. It is markt by radiating and concentric grooves and ridges. On the inner surface is an excavation for the inguinal buttress. This buttress rose about 15 mm. above the lower border of the bone.

This species differs from the living *T. scripta* and *T. elegans* in the form of the nuchal bone and the scutes overlapping it and in having had no notches in the borders of the carapace.

The nuchal here described has a good deal of resemblance to that on which *Pseudemys extincta* is based. The latter nuchal is that of a considerably larger specimen and is much smoother, the sculptural ridges having much less elevation. The nuchal scute, too, is longer relatively to the length of the bone. *P. concinna* has narrower nuchal and first vertebral scutes. The same is true of *P. rubriventris*.

Genus GRAPTEMYS Agassiz.

Shell moderately elevated, with dorsal keel more or less strongly developt. Neural plates hexagonal, with broad ends in front. Hinder border of carapace serrated. Inguinal buttresses rather feeble, articulated to the fifth costals. Humero-pectoral sulcus crossing behind the entoplastron. Plastron with a median notch behind. Alveolar surfaces of the upper and the lower jaws broad, flat, and smooth. Alveolar plate of the vomer in contact with the palatines. Choanæ between the hinder borders of the orbits. Symphysis of lower jaw long, equal to half of the distance between the quadrates.

The type of this genus is *G. geographica*, the geographic terrapin of the Mississippi Valley (figs. 1, 2, shell). This genus is distinguisht from *Chrysemys*, *Pseudemys*, and *Trachemys* by its maxillary and dentary alveolar surfaces, which are broad, flat, and without longitudinal ridges. From *Malaclemys* it differs in having broader alveolar surfaces, and especially in having the vomer in contact with the palatines on the alveolar surfaces. This articulation and the broad, flat crushing-surfaces of the jaws remind us strongly of the condition found in *Lytoloma*, as well as in the Toxochelyidæ and the Cheloniidæ; and show us that similar structures may arise independently in different groups. The evident purpose of these broad jaws in *Graptemys* is the crushing of hard food substances. *G. geographica* lives habitually on mollusks. The relations of the palatines and the vomer need further study.

There can be little doubt that *Graptemys* has been derived from *Malaclemys*.

Von Reinach described (Abhandl. Senckenb. Gesellsch., XXVIII, 1900, p. 92, plate xxx, fig. 1) a new genus and species (*Promalococlemmys boulengeri*) believed to be closely related to *Malaclemys*. There can be hardly a doubt that what is represented in his figure as the hinder end of the plastron is in reality the anterior end of another specimen.

Graptemys? inornata (Loomis).

Figs. 455, 456.

Chrysemys inornata, LOOMIS, Amer. Jour. Sci. (4), XVIII, 1904, p. 429, figs. 10, 11.

This species is based on a nearly complete shell which was discovered by Dr. F. B. Loomis in the year 1903, in the Titanotherium beds of the White River deposits, in Spring Draw Basin, 10 miles east of Creston, Meade County, South Dakota. The specimen lay beneath the skull of a titanothere; but, as no other skeletal parts of the turtle were found, the shell had probably drifted thither. Through the liberality of Dr. Loomis I have been enabled to study the specimen.

In outline the shell is broadly oval, broadly rounded in front, and rather pointed behind. The elevation of the shell in life can not be determined, it having been crusht flat during burial. The length of the carapace (fig. 455) is 303 mm.; the greatest width, 253 mm. Its margin is slightly excavated in front, with shallow notches at the outer ends of the posterior marginal sulci, and with a notch in the border of the pygal. There appears to have been a rounded carina on the front of the carapace, and this reappears near the rear.

Element.	Length.	Width.
Neural 1.....	27	22
Neural 2.....	27	22
Neural 3.....	28	24
Neural 4.....	26	23
Neural 5.....	24	20
Neural 6.....	18	27
Neural 7.....	15	25
Neural 8.....	9	18
Suprapygal 1..	25	22
Suprapygal 2..	26	53
Pygal.....	26	31

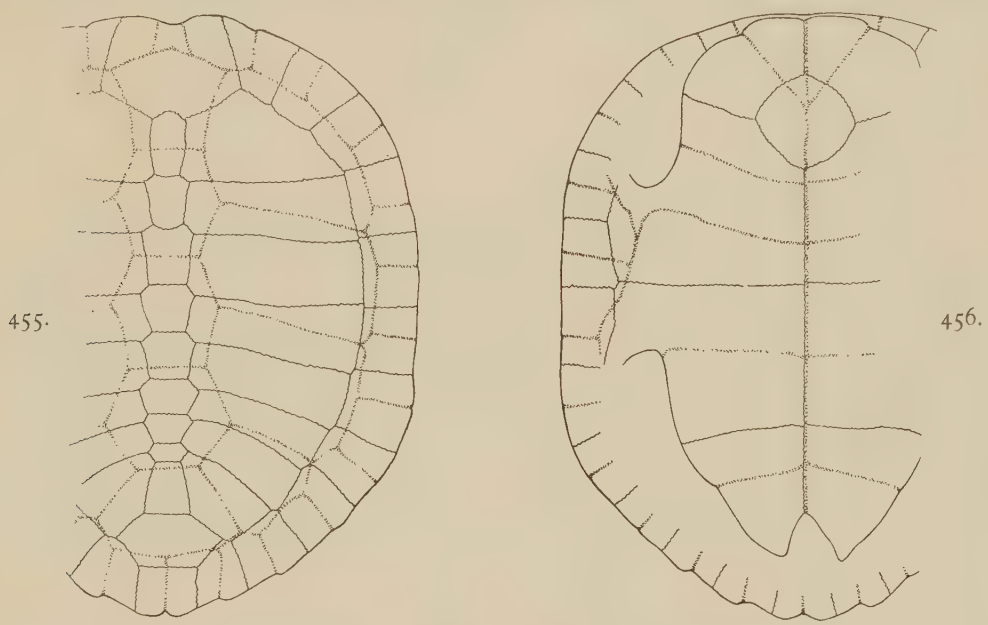
The nuchal bone has a length of 53 mm. and a width of 66 mm. The eighth neural is followed by 2 suprapygals. The accompanying table presents the dimensions of the median bones behind the nuchal.

The borders of the carapace in front of and behind the bridges are acute and the bones are thin. The second peripheral bone has a width of 38 mm. at right angles to the margin of the shell; the ninth, a width of 40 mm. The sulci between the marginal and the costal scutes run along on the peripheral bones a short distance below the costo-peripheral sutures, except in front, where they deviate further from the sutures. Posteriorly the sulcus crosses the midline on the rear of the second suprapygal. The nuchal scute is 14 mm. long and 15 mm. wide.

The vertebral scutes are narrow. Each of the anterior four is about 50 mm. wide. The fifth has an extreme width of 70 mm.

The total length of the plastron (fig. 456) is 272 mm.; but along the midline, from the front of the plastron to the bottom of the posterior notch, the length is about 265 mm. The anterior lobe has a length of about 85 mm. and a width of 140 mm. At the suture between the epiplastrals and the hyoplastra the width is 122 mm., and this width is continued backward about 22 mm. further. The entoplastron is 51 mm. wide. The anterior lip projects somewhat and has a width of 60 mm.

The posterior lobe has a width of 134 mm. and a total length of 90 mm. Toward the hinder extremity the lobe narrows rather rapidly and is posteriorly deeply notcht. The humero-pectoral sulcus passes behind the entoplastron. The gulars extend along the midline for



455. 456.

FIGS. 455 AND 456.—*Graptemys inornata*. Carapace and plastron of type. × about $\frac{1}{4}$.

455. Carapace. 456. Plastron.

47 mm.; the humerals, 29 mm.; the pectorals, 30 mm.; the abdominals, 63 mm.; the femorals, 53 mm.; the anals, 30 mm. The bridges have a width of 100 mm.

The present species is here referred with doubt to the genus *Graptemys* Agassiz. It can hardly belong to the genus *Chrysemys* as that is here defined and the type of which is *C. picta*. The shell of this White River species has some resemblance to that of *Graptemys geographica*, having a low rounded dorsal carina and an elongated first suprapygal, like the living species just named. The species may belong to either *Pseudemys* or *Trachemys;* but it will be necessary to have the skull in order to determine its relationships with certainty.

Genus TERRAPENE Merrem.

Shell usually short and broad, rarely elongated. Neural bones hexagonal, with the broader end forward. The eighth neural usually absent. Plastron as broad as the opening of the carapace, composed of two distinct portions movable on each other and the carapace, there being a ligamentous hinge between the hyoplastra and the hypoplastra and another on each side between the bones mentioned and the carapace. Zygomatic arch complete, deficient, or wanting. Alveolar surfaces of the jaws narrow and without ridges. Choanæ between fronts of orbits. Digits with little or no web. Tail short.

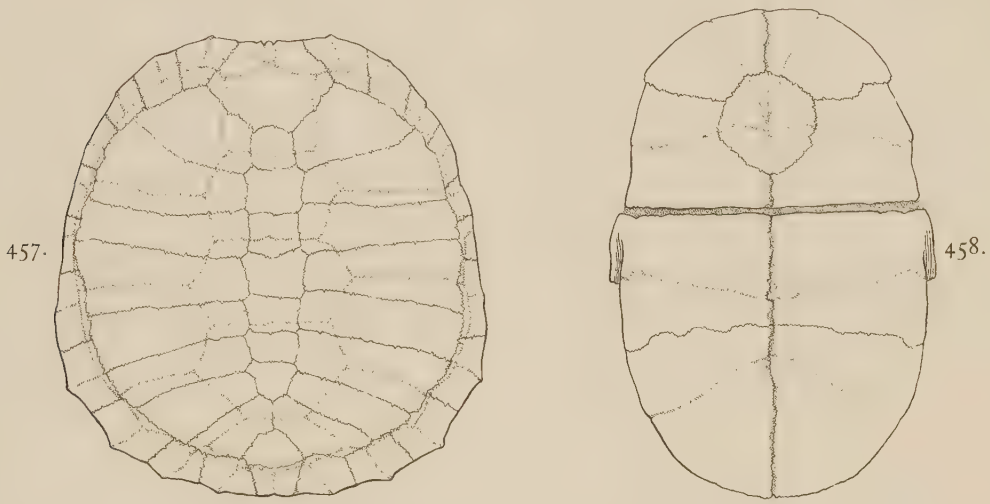
Type: *Terrapene carolina* (Linn).

The known members of this genus are confined to North America. The species are closely related, and their number is not certainly determined. On the number of the digits of the hinder feet and the condition of the zygomatic arch the genus has been, especially by

Cope, split into a number of genera. The type of *Terrapene* is *T. carolina*, and is extremely variable. Three fossil species have been described by Cope—*T. eurypygia*, *T. marnochi*, and *T. anguillulata*—but the latter appears to be identical with *T. eurypygia*. They all belong to Pleistocene deposits. Another species, *T. putnami*, was described by Hay from supposed Pliocene of Alifia River, Florida.

The shell of *Terrapene* is usually nearly as broad as long, but that of *T. major* is less than three-fourths as broad as long. It is sometimes high and vaulted, but occasionally, as in *T. ornata*, it is rather deprest.

Nothing is known regarding the origin of the genus. It appears not improbable that it has been derived from *Emys*, of which *Emys orbicularis* of Europe is the type. Of *Emys* there



FIGS. 457 AND 458.—*Terrapene ornata*. ×½. Specimen in A. M. N. H.

457. Carapace. 458. Plastron.

is also an American species, *E. blandingi*, an inhabitant of the northern United States and Canada as far westward as Wisconsin. In *Emys* there is a transverse hinge between the hyoplastrals and the hypoplastrals, less perfect than in *Terrapene*, and the lobes thus formed are somewhat movable on the carapace. It would require no great modifications of the shell and skull of *Emys* to transform it into *Terrapene*. *Emys* is found in Pleistocene deposits of various parts of Europe, and it is probable that the genus had its origin there, and that it migrated thence to North America. Doubtless, *Terrapene* was developt in North America.

Fig. 457 is a representation of the carapace of *Terrapene ornata*; while fig. 458 represents the plastron. The species now inhabits Kansas.

KEY TO FOSSIL SPECIES OF TERRAPENE.

A^1. Plastron very thick, the thickness of the hypoplastron being nearly one-third its length.. *putnami*
A^2. Plastron much thinner.
  a^1. Plastron with flat hinder lobe, its free border emarginated at end of femoro-anal sulcus. Middle of back flat transversely..... *marnochi*
  a^2. Plastron with hinder lobe convex, the free border not emarginate. Middle of back concave transversely ..... *canaliculata*
  a^3. Closely related to *T. carolina*. Vertebral scutes wide, the fifth in contact with the tenth marginal..... *eurypygia*

Terrapene putnami Hay.

Plate 56, figs. 7, 8; text-figs. 459–462.

Terrapene putnami, HAY, Bull. Amer. Mus. Nat. Hist., XXII, 1906, p. 30, figs. 4–7.

The present species is based on a single hypoplastral bone which was placed by Professor F. W. Putnam, then of the American Museum of Natural History, in the hands of the writer

for examination. This and some other bones were dredged by him in the Alifia River, Florida, about a mile above its entrance into Tampa Bay. With this bone there were obtained remains of some species of *Trachemys* and a peripheral of a very large *Testudo*, possibly *T. crassiscutata* (Leidy). The writer has been informed that these bones were accompanied by bones of horses, tapirs, etc. The remains seem therefore to agree with those taken from the Peace Creek beds, near Arcadia, DeSoto County, of the same state. The latter bone bed has been declared to be of older Pliocene age, but the evidence appears to be contradictory.

This new species of box-tortoise is remarkable for its size and the great thickness of its plastron. The length of the left hypoplastron (plate 56, fig. 7), measured along the midline, is 73 mm., and the width is almost exactly the same. If this bone had the same ratio to the other

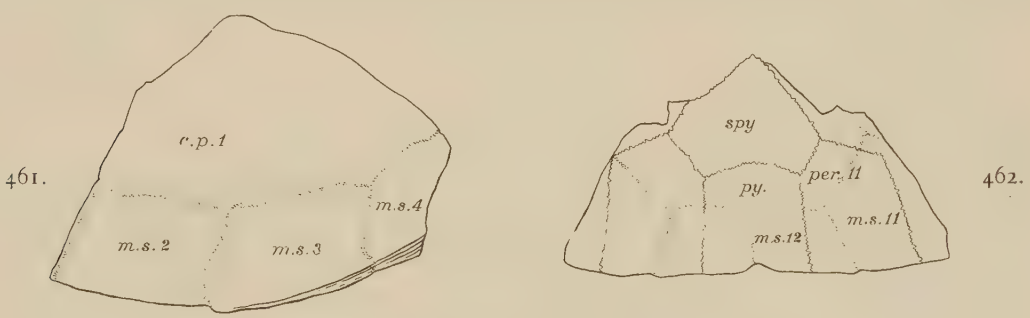
FIG. 459 AND 460.—*Terrapene putnami*. Hypoplastron of type. $\times\frac{2}{3}$.

459. Section from articulation with opposite hypoplastron (on right) to lateral hinge (on left).
460. Face articulating with its fellow. Anterior end of the bone at right hand.

portions of the shell that the corresponding bone has in *T. carolina*, the carapace must have been 265 mm. long, and the width about 200 mm.

At the midline of the plastron, just in front of the union of the hypoplastron with the xiphiplastron (fig. 460, on the left), the former bone is 22.5 mm. thick. In a specimen of *T. carolina* whose hypoplastron is 38 mm. wide the thickness at the point named is 4 mm. or less. In the fossil the thickness becomes reduced laterally, so that at two-fifths the distance toward the lateral hinge (fig. 459) it is only 12 mm. It then increases and at the hinge is 15 mm. Toward the anterior end of the bone the thickness diminishes to 12 mm.

The hinder portion of the lateral hinge (plate 56, fig. 8) is broken away. At its anterior end there is a deep and rough pit for a process proceeding from the fourth and fifth peripherals,



FIGS. 461 AND 462.—*Terrapene putnami?*. Fragments of carapace. $\times\frac{2}{3}$. Specimen in Vanderbilt University.

461. Left side of front of carapace. *c. p.* 1, part of first costal plate; *m. s.* 2, *m. s.* 3, *m. s.* 4, second, third, and fourth marginal scutes.
462. Rear of carapace. *m. s.* 11, *m. s.* 12, eleventh and twelfth marginal scutes; *per.* 11, eleventh peripheral; *py*, pygal; *spy*, suprapygal.

as in *T. carolina*. The hinder border of this pit is about 22 mm. behind the anterior border of the bone. Behind this comes the flat, rough, and perpendicular surface, about 14 mm. high, that articulated loosely with the fifth and sixth peripherals, forming one side of the lateral hinge. This surface is relatively broader and flatter than in *T. carolina* and resembles more that found in *T. ornata*. It is likewise broader and flatter than the same surface in *T. marnochi*, judging from the carapace in the American Museum of Natural History so identified. In that specimen the hinge surface on the carapace is only 8 mm. wide.

The hyohypoplastral hinge hardly differs from that of *T. carolina*, except in thickness, which in *T. putnami* is close to 12 mm. The upper half of the hinge (fig. 460) is rough for the

attachment of the ligament. Near the outer end of this hinge nearly the whole surface is rough. The lower half of the anterior face projects in front of the upper half and is mostly smooth and was covered with the horny epidermis.

On the lower surface of the bone is seen the abdomino-femoral sulcus. The abdominal scutes were, in fore-and-aft extent, 33 mm. laterally and 55 mm. at the midline. On this surface are some faint grooves produced by the growth of the scutes. Two of these grooves near the anterior border are especially conspicuous. This species is dedicated to Prof. Frederick W. Putnam, the distinguisht archeologist and ethnologist.

In a considerable collection of fossil turtle bones sent to him from Vanderbilt University, Nashville, Tennessee, the writer finds 2 fragments of the carapace of a large box-tortoise. This collection was obtained in Hillsboro County, Florida, by Dr. W. H. Jarman and belongs to the university named above. The fragments probably belong to *T. putnami*.

One portion (fig. 461) consists of the areas occupied by the second, third, and a part of the fourth left marginal scutes and a portion of the contiguous first costal. This fragment, compared with the carapace here referred to Cope's *T. marnochi*, indicates a carapace about 320 mm. long. The bones are solidly co-ossified and the sutures obliterated, showing that the individual was aged. Where the suture between the first and second peripherals should occur the bone is 14 mm. thick. The free edge is acute. In the area covered by the fourth marginal the border is revolute. The second and the third marginals measure each 33 mm. along the free border and are about 20 mm. high.

In the same lot of bones is a fragment (fig. 462) furnishing the suprapygal, the pygal, and the right and left eleventh peripherals. The bones are co-ossified, but the sutures may be traced. The individual probably had a length of about 250 mm. The free edge is acute and somewhat recurved. The eleventh peripheral is 10 mm. thick. The fifth vertebral scute is 50 mm. wide, while that of the carapace of *T. marnochi* is 40 mm. wide. The two twelfth marginals taken together measure 40 mm.; those of *T. marnochi*, 37 mm.; the height of the scutes in the two species is the same, 13 mm. The height of the eleventh marginal is 28 mm.; that of *T. marnochi*, only 32 mm. It is evident that the Florida specimen does not belong to *T. marnochi*.

Terrapene marnochi (Cope).

Plate 58, figs. 1, 2.

Cistudo marnochii, Cope, Proc. Amer. Philos. Soc., xvii, 1878, p. 229; Amer. Naturalist, xxiii, 1889, p. 161, Feb.
Cistudo marnochii, Cope, Amer. Naturalist, xix, 1885, p.1208.
Terrapene marnochii, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 449.

This species was founded on the posterior lobe of an individual which was discovered by Gabriel W. Marnock, in the Equus beds of Atascosa County, Texas. What has become of the specimen is not known. It does not appear to be in the Cope collection of fossil reptiles in the American Museum of Natural History at New York. The specimen was not figured by Cope. The following is his description of the type:

> Represented by the posterior lobe of the plastron of an individual of twice the bulk of the existing North American *Cistudos*. It is broadly rounded posteriorly, and there is an emargination at the femoro-anal dermal suture. The anterior suture is straight, as is also the lateral, which measures more than a third the length of the entire lobe. On the upper side of the angle included by these sutures is the fossa for fixed attachment with the carapace. The beveled face of the fore edge of the lobe is quite wide. The dermal sutures are well marked. The anal scuta are large, their median length being half that of the lobe. The common femoral suture is only half as long as the ventral. The inferior surface is nearly flat in every direction, and the surface is smooth. The posterior border of the specimen is broken away.
>
> This species was obtained from the same formation as the last, by Gabriel W. Marnock, to whom I dedicate it.

In the American Museum there is a large carapace (plate 58, figs. 1, 2) of a species of this genus which was found in the Cope collection of fossil reptiles, but which appears never to have been mentioned by Professor Cope. Accompanying it is a label stating that it was found in the "Elephant beds," on San Diego Creek, Texas, and had been sent by Mr. William

Taylor. We learn from the American Naturalist (vol. XIX, 1885, p. 1208) that this gentleman had collected materials for Professor Cope in the Equus beds, in the region about San Diego. This locality is about 80 miles south of that which furnisht the type of *T. marnochi*.

The catalog number of the San Diego specimen is 3936. The matrix was a mixture of gravel and sand.

It is assumed for the present that the specimen referred to belongs to *T. marnochi*. The type is spoken of as being large. Unfortunately Professor Cope gave no measurements. The length of the carapace of the San Diego specimen is 215 mm.; the breadth is 141 mm. The width is therefore two-thirds the length, indicating an elongated form. *T. ornata*, of Kansas, is nearly as wide as long. *T. major*, of Louisiana, is relatively elongated, but even here the width is three-fourths of the length. The outline of the carapace is like that of *T. major*, the hinder portion being only slightly wider than the middle. The width at the line of the hinge is 137 mm.; at the seventh peripherals, 147 mm. The height is 95 mm., two-thirds the width. The middle of the back is rather flat. There are traces of a dorsal keel anteriorly, and these traces are better defined on the area of the third vertebral scute, and are yet perceptible on the fourth. On each side of this keel, on the third and fourth vertebral scutes, there is a distinct broad, but shallow, channel. Most of the area of the fifth scute is concave.

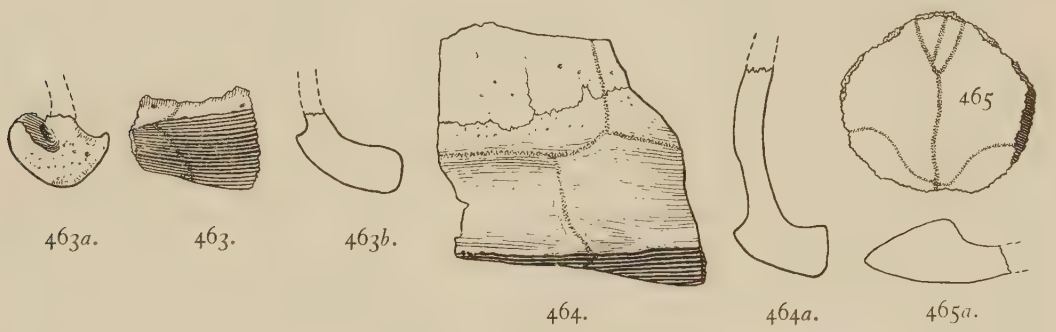
Scute.	Length.	Width.
1	50	38
2	47	41
3	49	46
4	48	42
5	36	39

The margins of the carapace are little flared upward, far less than those of *T. major*. A distinct keel runs along each side, joining the anterior free border of the carapace with the hinder free border.

The individual was an aged one, and the sutures between the bones are completely obliterated.

The sulci are everywhere deeply imprest. The vertebral scutes are unusually narrow. The table herewith presents the dimensions of these scutes. The lengths are taken along the midline; the widths are the maximum.

The anterior end of the first vertebral projects forward between the first pair of marginals. Similarly the anterior ends of the third and fourth vertebrals project forward each into the hinder border of the scute in front. The marginal scutes are large. The first rises 22 mm. from the free border, the sixth 23 mm. above the lateral keel, and the ninth 27 mm. above the free border.



FIGS. 463–465.—*Terrapene canaliculata*. Portions of the type. $\times \frac{2}{3}$.

463. Fourth right peripheral, with sections of the ends (*a*, anterior; *b*, posterior).
464. Region of seventh and eighth marginal scutes, with section (*a*).
465. Entoplastron and section (*a*) of border of hinder lobe.

Terrapene canaliculata Hay.

Figs. 463–465.

Terrapene canaliculata, HAY, Bull. Amer. Mus. Nat. Hist., XXIII, 1907, p. 850, figs. 5-7.

The fragmentary remains that testify to the former existence of this species belong to the U. S. National Museum, having been sent there many years ago by Dr. J. P. Scriver. They had been found on either Whitemarsh or Skedaway Island, below Savannah, Georgia. The

exact age of the deposits is not known, but they belong probably either to the late Pliocene or to the Pleistocene.

The individual was of larger size than any belonging to any existing species. The right fourth peripheral (fig. 463) has a length of 26 mm., from which we may infer that the carapace had a length of about 220 mm. The anterior end of this peripheral has a thickness of 8 mm.; the hinder end a thickness of 19 mm. On the outer surface is a sharp longitudinal keel, which ran from the free border of the anterior peripherals to that of the posterior peripherals. This keel borders outwardly a broad gutter-like groove. Fig. 464 shows the region of the seventh and eighth marginal scutes, with a section across the seventh. Portions of the second and third costal scutes are presented. The thickness of the costals varies from 4 mm. to 6 mm. A fragment of the dorsal region shows that the midline of the carapace was concave transversely.

The lateral hinge-line appears to have had a length of about 70 mm. Its thickness is 10 mm. The entoplastron (fig. 465) is subcircular in outline. It varies in thickness from 5 mm. to 7 mm. The border of the hinder lobe, at the hypoxiphiplastral suture, is 13.5 mm.

Terrapene eurypygia (Cope).

Figs. 466–470.

Cistudo eurypygia, Cope, Ext. Batrach., Reptilia, Aves N. A., 1869, p. 124.
Terrapene eurypygia, Hay, Proc. Acad. Nat. Sci. Phila. 1902, p. 385, figs. 6, 7; Bibliog. and Cat. Foss Vert. N. A., 1902, p. 449; Maryland Geol. Surv., Pliocene and Pleistocene, 1896, p. 169, pl. xi, fig. 2.

The present species has as its type a fragment of the hinder portion of the carapace which was discovered by Dr. Samuel Harrison, on Oxford Neck, Talbot County, Maryland, in Pleistocene deposits, associated with remains of *Elephas primigenius*, *Cervus canadensis*, *Odocoileus virginianus*, and *Chelydra serpentina*. This type is now in the American Museum at New York and bears the catalog number 1484. It is here represented by fig. 466.

Cope's type presents a portion of the right seventh costal plate, portions of the costals of the eighth pair, the suprapygal, the pygal, and the tenth and eleventh peripherals. Those characters which in this type appear to distinguish the species from *T. carolina* are the greater breadth of the fifth vertebral scute and the union of this vertebral with the tenth marginal scute. It is proper to remark here that the present writer, in his description of this species in the Proceedings of the Philadelphia Academy, called the tenth marginal the ninth.

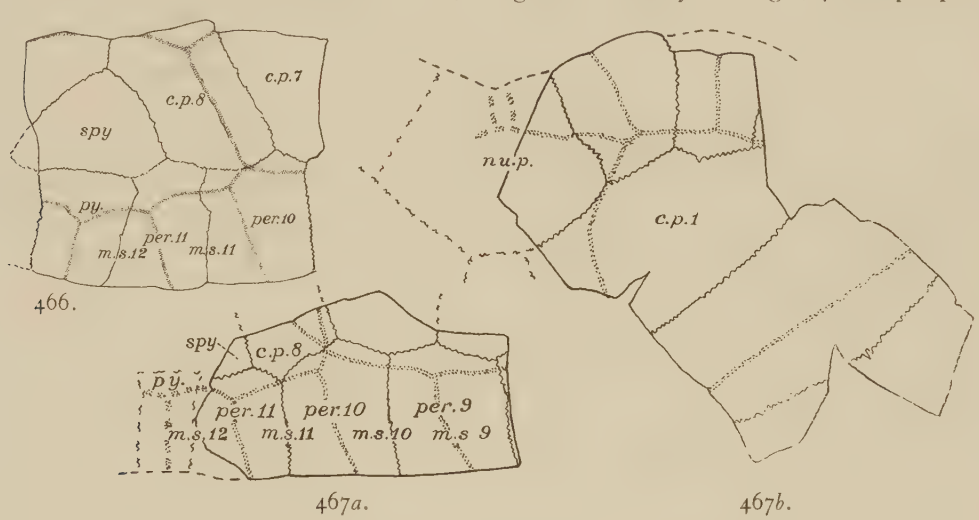
An estimate makes it probable that the individual to which the type fragment belonged had a length of carapace equal to about 140 mm. The fifth vertebral scute had a width of 40 mm. The width of this vertebral in *T. carolina* is variable, but out of 6 individuals observed, only 1, with shell 130 mm. long, had this scute as much as 39 mm. wide. In *T. eurypygia* the fifth vertebral joins the tenth marginal scute by a sulcus 4.5 mm. long. Usually in *T. carolina* these two scutes fail to reach each other by some millimeters. As stated by the author elsewhere, an examination of eighteen specimens of *T. carolina* showed that in only one the fifth vertebral was in contact with the tenth marginal on both sides, while in another these scutes were in contact on only one side of the carapace. Relying on the type alone we might conclude that possibly *T. eurypygia* is only an individual variation of *T. carolina*.

In 1899 (Jour. Phila. Acad., xi, pp. 193–267) Professor Cope described various remains of the vertebrates which had been collected by Messrs. Dixon and Mercer in the Port Kennedy cave. Among other things there were three tortoises found, viz.: *Clemmys insculpta*, *C. percrassa*, and *Toxaspis* (*Terrapene*) *anguillulata*. There belonged to the collection, however, another box-tortoise which was not mentioned by Cope, and was perhaps not seen by him. These remains consist of almost the whole of the plastron and of various fragments of the carapace and the right humerus.

An examination of these bones showed that they belonged either to *Terrapene carolina* or to a species closely related to it. It was soon observed that the tenth, or antepenultimate, marginal scute comes into contact with the last vertebral (fig. 467*a*), a condition which recalled Cope's *Cistudo eurypygia*, and a close comparison proved that they are identical, one of the portions of the Port Kennedy specimen being fortunately the right margin of the rear of the shell from near the midline to the hinge. The question therefore arises whether or not the new material confirms Cope's view of the distinctness of the species.

The unusual width of the fourth and fifth vertebral scutes is proved by Cope's type and confirmed by the Port Kennedy specimen. Belonging to the latter is a fragment of the carapace presenting a part of the nuchal, a part of the first and second costals and the first and second peripherals (fig. 467*b*). In *T. carolina* the first vertebral does not usually encroach on the first peripheral bone; in the fragment alluded to above, the vertebral reaches over on the first peripheral nearly to the sulcus between the first and second marginals. The anterior vertebral must have been 34 mm. wide, about 6 mm. wider than in a specimen of *T. carolina* at hand. We must conclude that the other vertebrals were wider than they commonly are in *T. carolina*. An estimate makes it probable that the fourth vertebral in *T. eurypygia*, type, was about 42 mm. wide.

Fig. 467*a* presents a view of the fragment of the rear of the carapace of the Port Kennedy specimen, the interrupted lines having been added in order to show the position of the fragment. The crossing of the sulci on the upper portion of the drawing indicates the presence of a small scute cut off from the fifth vertebral, a slight abnormality. In fig. 467*a* the peripherals



FIGS. 466 AND 467.—*Terrapene eurypygia*. ×1. Portions of Carapace.

466. Rear of carapace of type. *c.p.* 7, *c. p.* 8, seventh and eighth costals; *m. s.* 11, *m. s.* 12, eleventh and twelfth marginal scutes; *per.* 10, *per.* 11, peripherals; *py*, pygal; *spy*, suprapygal.

467*a*. Rear of carapace. *c. p.* 8, eighth costal plate; *per.*9, *per.* 10, *per.* 11, ninth to eleventh peripherals; *m. s.* 9, *m. s.* 10, *m. s.* 11, *m. s.* 12, ninth to twelfth marginal scutes; *py*, pygal; *spy*, suprapygal. The letters *m. s.* of ninth marginal lie partly on tenth marginal.

467*b*. Front of carapace. *c. p.* 1, first costal bone; *nu. p.*, nuchal bone.

and marginals are indicated. The tenth scute is the one lying partly on the ninth peripheral and partly on the tenth. In both figures the bony sutures are represented by zigzag lines, while the sulci between the scutes are shown by dotted lines.

The plastron of the Port Kennedy specimen is 131 mm. long. In general it resembles that of *T. carolina*. The width of the hinder lobe is 79 mm.; the length was almost exactly the same. In the case of 6 specimens of *T. carolina* examined the width of this lobe is from 4 to 6 mm. wider than long; in one individual the width is 2 mm. less than the length. The form and dimensions of the scutes of the plastron are essentially as they are in *T. carolina*.

A study of the plastron of the Port Kennedy specimen makes it evident that this portion of the shell was almost everywhere thicker than in the corresponding parts of *T. carolina*. Nearly the whole of the border of the anterior lobe is thicker and with a more rounded edge. The hypoplastron of *T. carolina* at the hinge is 3 mm. thick; that of *T. eurypygia*, 4 mm. The sloping, scute-covered border of the hinder lobe, at the union of hypoplastron and xiphiplastron, is in *T. carolina* 5 mm. thick; in *T. eurypygia*, 7 mm. thick. This border is also wider in the latter species than in any specimens of the living species at hand.

Fig. 468 represents the plastron of the specimen described above from the Port Kennedy cave. It resembles that of *T. carolina* but appears to be relatively more elongated.

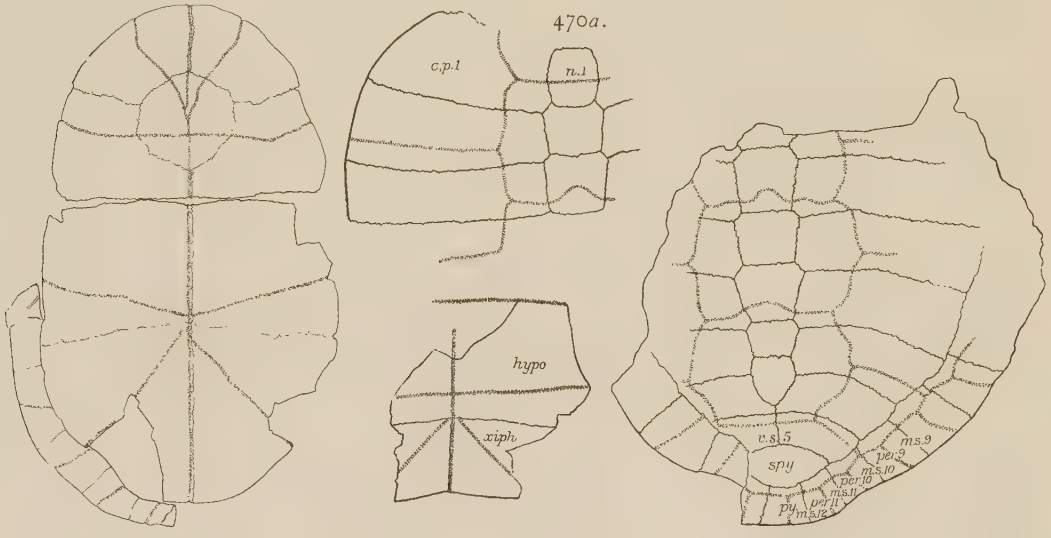
Professor Cope in 1899 (Jour. Phila. Acad., xi, p. 196, plate xix, fig. 1) described and figured a box-tortoise which he called *Toxaspis anguillulatus*. Of this tortoise he had at command five fragmentary carapaces on beds of matrix, three parts of plastrons, and two moulds of carapaces. All these had been obtained in the cave near Port Kennedy.

The type of Cope's *Toxaspis anguillulatus* is number 155 of the collection of the Philadelphia Academy. This is figured as cited in the synonymy at the head of this article; but the figure is poorly printed and does not well show the structure. A diagram of the specimen (fig. 469) is here presented; but even in the specimen some sutures are obscure and on the left side the hinder peripherals have been somewhat displaced.

Neural.	Length.	Width.
Fig. 469:		
3	16	17
4	14	17
5	14	17
6	9	15
7	13	12
Fig. 470:		
1	16	13
2	13	16
3	15	17

Professor Cope did not compare his species with the one which he had described in 1869. The present writer, having examined Cope's types of both species, concludes that they are identical. Cope stated that his type carapace, No. 155, is of larger size than that of any of the existing species of what he called the Terrapenidæ. However, a comparison with a shell of *T. carolina* shows that the carapace was not more than 140 mm. long, perhaps not more than 130 mm.; and occasional individuals of *T. carolina* attain that size, while some of *T. major* become still larger. Cope believed that his *T. anguillulatus* had a more deprest shell than any of the living species, but this may be doubted.

Another of Cope's specimens is numbered 154. This (fig. 470) furnishes the three anterior neurals. Their measurements are given in the table above.



468. 470*b*. 469.

Figs. 468–470.—*Terrapene eurypygia*. Portions of shells. $\times\frac{1}{2}$.

468. Plastron.
469. Rear of carapace of type of *Toxaspis anguillulatus*.
470*a*. Front of carapace. No. 154 Phila. Acad.
470*b*. Portion of hypoplastra and xiphiplastra. No. 154 Phila. Acad.

From the measurements of No. 155 (fig. 469), given in the table above, it will be seen that all the neurals, except the first and the last, have the width considerably greater than the length. They appear to be somewhat broader than those of *T. carolina*.

The eighth neural was not developt. The seventh is not as long as the width of the seventh costals; and, as a result of these conditions, the seventh costals meet on the midline behind the seventh neural and the eighth costals join by their whole proximal width. In some specimens of *T. carolina* there is a long and narrow eighth neural.

In the type of *T. anguillulatus*, as shown in the figure (fig. 469), the hinder peripherals on the left have been pushed forward over the ends of the costals.

The suprapygal is 11 mm. high and 25 mm. long. The eighth peripheral is 5.5 mm. thick.

From No. 154 we learn that the first vertebral scute was 38 mm. wide and the second 40 mm. From No. 155 it is seen that the second and third were each 44 mm. wide; the fourth, 42 mm.; and the fifth, 40 mm. What is of special interest is that in No. 155 the tenth marginal scute comes into contact with the outer extremity of the fifth vertebral scute. This is the character on which *T. eurypygia* was based. A fragment of the plastron of No. 154 of the Philadelphia Academy shows that the femoro-anal sulcus extends forward to the hypoxiphiplastral suture. Cope states that this character had not been observed by him in any other species of the family. It is, however, occasionally seen in *T. carolina*.

Cope describes a peculiar and fine sculpture as present on the type of his *Toxaspis anguillulatus*. This is a well-markt vermiculation. At the borders of the costals the ridges place themselves at right angles with the sutures. A similar vermiculation is seen in the type of *T. eurypygia*, but no modification of it is seen where the seventh costal joins the eighth.

Family TESTUDINIDÆ Gray.

Cryptodira having most of the characters of the Emydidæ, but modified for a more strictly terrestrial life. Size medium to very large. Jaws fitted for a vegetable diet. Palate vaulted. Zygomatic and postorbital arches present; the temporal roof not otherwise represented. Stapedial notch closed. Neck retractile within the shell. Plastron suturally united with the carapace, with the buttresses rarely ascending within the carapace. The bridge broad. Neural bones sometimes mostly hexagonal; but often, especially in *Testudo*, octagonal ones alternating with tetragonal. Penultimate suprapygal usually bifurcate, with its limbs resting on the hinder peripherals and enclosing the hindermost suprapygal. Plastral bones nine. The epiplastrals usually thickened and projecting as a lip. The procoracoid process forming with the body of the scapula more than a right angle. Coracoids greatly expanded at the median border. Humerus with the radial and ulnar processes approximated on the ventral side. Digits short, without rudiment of web. Phalanges not more than 2 in any digit; all shortened; anterior claws usually 5, sometimes only 4; hinder claws 4. Sulcus between the costal and the marginal scutes usually coinciding with the sutures between the costal and peripheral bones.

The present family is here regarded as including 5 living genera—*Testudo*, *Gopherus*, *Kinyxis*, *Pyxis*, and *Homopus*. It seems not improbable that a more accurate study of the skeletons of living tortoises would result in the establishment of additional genera. *Kinyxis* is confined to tropical Africa, *Pyxis* to Madagascar, and *Homopus* to southern and western Africa. *Testudo* is represented in the present fauna, or has been within historical times, by more than forty species, and these belong to South America, the Galapagos Islands, Europe, Asia, Africa, Madagascar, and the Aldabra, Maritius, Seychelles, Comoro, and Rodriguez Islands. *Gopherus* (*Xerobates*) includes the Testudinidæ of North America, altogether 3 species.

The extinct genera belonging to this family are *Hadrianus*, *Achilemys*, and *Stylemys*. Besides the extinct species referred to the genera just named, a few belong to *Homopus* and many to *Testudo*.

Extinct species of *Testudo* are known with certainty from the Lower Oligocene to the deposits of the recent period. A very large species, *T. atlas*, is known from the Pliocene of the Siwalik Hills, India. Its shell reached a length of 6 feet. Other Pliocene species have been described from Europe, among them *T. perpiniana*, from France. Various species are known from the Miocene of Europe, among them *T. leberonis*, from Mount Lebéron, France. *T. gigas* is known from a nearly complete specimen and *T. eurysternum* from fragments, both from the Upper Oligocene of France. A specifically unnamed specimen of the genus is noticed by Lydekker (Cat. Foss. Rept., Brit. Mus., III, p. 91) as being represented by an anterior peripheral from the Lower Oligocene of France. As remarkt by Lydekker (op. cit., p. 72) there is no known reason why some of the Lower Tertiary species described under the name *Testudo* may not belong in reality to *Hadrianus*. Zittel states that the oldest known land-tortoise in Europe is *T. lamanoni* Gray, from the Oligocene gypsmergel of Aix, in Provence.

This formation is placed by Lapparent at the base of the Oligocene. The specimen is a very imperfect one, and it may be said that the genus is only approximately determinable. Dr. A. E. Andrews (Surv. Dept., Pub. Works Ministry, Geol. Surv. Egypt, 1903; Catalogue Tert. Vert. Fayum, Egypt, 1906, p. 278, plate xxiv) has described a land-tortoise from the Upper Eocene of Egypt to which he has given the name *Testudo ammon*. If a true *Testudo*, it is the oldest known. The publisht figures show that the neurals are variable in form, but the relationships to typical *Testudo* are so close that it may be accepted as belonging to this genus. In some respects it appears to be intermediate between *Testudo* and *Hadrianus*.

The oldest known representative of the family is *Hadrianus majusculus*, of the Wasatch beds of New Mexico.

The following table presents a list of the North American fossil species belonging to the Testudinidæ so arranged as to exhibit their geological sequence:

		Species.
Pleistocene.	Equus, or Sheridan beds.	Testudo hexagonata, T. laticaudata, T. atascosæ (Texas).
Pliocene.	Peace Creek.	Testudo crassiscutata (Florida).
	Blanco.	Testudo pertenuis, T. turgida, T. campester (Texas).
Miocene.	Loup Fork.	Testudo klettiana, T. undata (New Mexico); T. niobrariensis, T. hollandi, T. edæ (Nebraska); T. impensa (Montana); T. gilberti, T. orthopygia (Kansas); T. arenivaga (Nebraska).
	Deep River and Pawnee Creek.	Testudo pansa, T. osborniana (Colorado); T. arenivaga (Nebraska); T. emiliæ (South Dakota). Testudo vaga (Wyoming); ?T. peragrans, T. farri, T. inusitata (Montana).
Oligocene.	John Day.	Stylemys conspecta, S. capax (Oregon); S. calaverensis (California).
	White River.	Testudo brontops, T. thomsoni (South Dakota); ?T. peragrans (Montana); T. ligonia, T. cultrata, T. laticunea, T. amphithorax, T. quadrata (Colorado); T. exornata (Assiniboia); Stylemys nebrascensis (South Dakota, North Dakota, Nebraska, Wyoming).
Eocene.	Unita.	Hadrianus tumidus (Utah).
	Jackson.	Hadrianus schucherti (Mississippi).
	Bridger.	Hadrianus corsoni (Wyoming); Achilemys allabiata (Wyoming).
	Wasatch.	Hadrianus majusculus (New Mexico); H. corsoni? (New Mexico).
	Puerco.	

We can not doubt that the predecessors of *Hadrianus* will yet be found in the Puerco beds or their equivalents. We may even look confidently for more primitively constructed Testudinidæ in some of the Upper Cretaceous deposits. They are more likely to occur in river valley formations or æolian accumulations.

Considering the large size of *Testudo brontops*, the grade of its differentiations, and the great number of species of *Testudo* which made their appearance in the Oreodon beds of the Oligocene we may be sure that species of the genus will yet be discovered in some of the upper formations of the Eocene of America; as they have already been found in the Upper Eocene of northern Africa.

Nevertheless, it seems to the writer that the family was, in the earlier half of the Eocene, in a stage of development represented by *Hadrianus corsoni* of the Bridger, and that *Testudo brontops*, with its only slightly differentiated costal plates, represents a stage which existed possibly even in the Upper Eocene. It may be concluded therefore that any members of the family that shall be found in the Puerco and Upper Cretaceous will display further approximations to the Emydidæ.

It will be interesting to consider in the light of knowledge derived from both the living and the fossil species of the family the special characters which they have developt since their first appearance: as we might say, the goal toward which they have been striving.

With regard to the shell we see that it is usually very high and convex. There are various exceptions to this statement; nevertheless, we find no species so deprest as some of the Emydidæ; and the height and convexity will average much higher than among the species of the

latter family. The ends to be subserved by this convexity may be various. We may suppose that it would be much more difficult for a carnivorous animal to effect an entrance into such a shell than into one deprest and whose borders may be spanned by the jaws of the enemy. Again, the vaulted shell provides greater space for the lungs; and the investigations credited by Hoffmann (Brown's Klass. and Ordn.: Schildkr., p. 344) to Dr. Joseph Jones but really made by Louis Agassiz (Contrib. Nat. Hist. U. S., vol. I, p. 283) show that the capacity of the lungs of *Gopherus polyphemus* is much greater than that of Emydidæ having an equal length of shell, except *Terrapene*, which has similar habits of life. Even the earlier known forms of the Testudinidæ, as *Hadrianus* and *Stylemys*, have the shell high and vaulted; and this fact suggests that the deprest form of some existing species may be due to adaptations to recent conditions. The flattened carapace of *Gopherus polyphemus*, for instance, may have relation to the burrowing habits of the species.

Among the Emydidæ the neural bones are usually hexagonal, with the broader end of the bone in front. Such, too, is the case with some of the Testudinidæ. In *Stylemys nebrascensis* we find this condition prevailing; but occasionally a specimen is found in which the second one is octagonal. In *S. conspecta* and *S. capax*, of the John Day beds, there is further advancement—the second is octagonal, while the third is tetragonal. Too much weight ought not to be attacht to single specimens having modifications of this sort; as is illustrated by the fact that in the American Museum of Natural History there is a specimen of *Chelydra serpentina* in which the second, fourth, and fifth neurals are octagonal, while the third is tetragonal. Nevertheless, among the Testudinidæ a high degree of differentiation of the neurals is the rule. When we come to the genus *Testudo* itself we find the alternation of octagonal with tetragonal neurals the prevailing arrangement. In *Kinyxis*, according to Boulenger's figure (Cat. Chelonians, fig. 41), the neurals are hexagonal with the broad end behind, a form the reverse of that common among the Emydidæ. In *Homopus* the emydoid condition prevails, except that the third is tetragonal.

The costals háve suffered remarkable modifications among the Testudinidæ. In most other turtles these plates, from the second to the sixth inclusive, have the proximal and the distal ends of each costal of nearly the same width. In most species of *Testudo* and in *Gopherus* the proximal ends of the second, fourth, and sixth are much narrowed, while the distal ends are greatly widened. On the other hand, the proximal ends of the third and fifth are broad, while the distal ends are narrow. The proximal ends of costals 3 and 4 are in contact with 3 neurals each. The 5 costals concerned appear thus to be dovetailed with one another. The mechanical advantages of this arrangement have been discust by A. Bienz (Rev. suisse Zool., etc., III, 1895, p. 99). These modifications of the costals are not conspicuous in *Hadrianus* and in *Stylemys nebrascensis*, but they become very manifest in the species of *Stylemys* from the John Day beds. In *Testudo brontops* of the lowest Oligocene, the neurals display a high grade of differentiation, and, in harmony with this, the upper ends of the costals are modified so as to unite alternately with 1 and with 3 neurals; but there is no great difference in the widths of the upper and lower ends of each costal.

In most turtles the position of the rib is very distinctly shown on the visceral side of each costal plate; and the heads of the ribs are broad and thick. These heads join their respective vertebral centra at the anterior ends of the latter, and at least the anterior ones come into contact also with the next centrum in advance. In the Testudinidæ the ribs show only faintly on the under side of the costals and the rib-heads are usually greatly reduced. In a specimen of *Testudo radiata* from Madagascar, having the shell 305 mm. long, the rib-heads of the second to the sixth costal plates may be 30 mm. long; but they are very slender blades 5 mm. thick horizontally and 2 mm. high, expanding somewhat toward the proximal ends. In *Gopherus* only the merest traces of the rib-heads remain of those belonging to the costals in front of the seventh; and these vestiges adhere to the centra and to the neural. In *T. tabulata* the rib-heads are all much reduced. Many of these are wholly free from the costal plates and have become co-ossified with the under sides of the neural bones. Intermediate stages are to be seen in this species. This condition illustrates well the manner in which the ribs, probably free from the costals in the most primitive turtles, have become consolidated with them.

When we examine *Hadrianus* we find that the rib-heads were somewhat reduced, but still of considerable size. In *Stylemys* they are still more reduced. A careful examination of a

series of fossil turtles of the various geological periods would doubtless show a gradual reduction of the size of the rib-heads in this family.

The distal ends of the costal ribs of the Testudinidæ have become reduced in an interesting way. In the great majority of turtles the distal ends of these ribs project more or less beyond the margins of the costal plates, and the projecting ends are usually received by pits in the adjacent peripherals. In most of the Testudinidæ the ends of the ribs have disappeared. In *Gopherus* we find that, instead of the rib entering the peripheral, a broad process of the peripheral rises and enters a notch on the inside of the costal plate, an interesting reversal of conditions. The relations of the ribs and peripherals in *T. radiata* are very similar. In *T. tabulata* no conspicuous process is found on either the costal plate or on the peripheral. In *Hadrianus*, as in *Gopherus* and most species of *Testudo*, a process of the peripheral enters an excavation in the inner surface of the costal. On the other hand, in *Stylemys* the extremity of the rib fits into a pit in a peripheral, just as in the Emydidæ.

In typical Testudinidæ of to-day the peripherals and contiguous costals are articulated, not only by the processes just described, but also by digitating sutures, and these are usually better developt than in the Emydidæ. In *T. radiata* long slivers of bone arising from the peripherals interdigitate with shorter processes from the costals. On the other hand, in *Stylemys* and *Hadrianus* there appear to have been no such digitations; but the rounded border of each peripheral joins the similar border of the neighboring costal.

In the majority of the Testudinidæ the epiplastral bones are thickened for some distance on each side of their symphysis. The thickening takes place on the upper side of the bones. At the hinder border of the thickening, on each side of the midline, the elevation drops off suddenly to the level of the entoplastron. In many species the ledge thus formed and looking backward is excavated more or less deeply. Usually the thickened epiplastra project more or less beyond the general curve of the rest of the anterior lobe, and there is thus formed a conspicuous epiplastral lip. This lip presents various forms in the different species and, tho subject to variations, it furnishes valuable specific characters. The lip is conspicuously developt in *Hadrianus*, as in most species of *Testudo*. In *Stylemys* the front of the epiplastra is thickened, but it does not project beyond the curvature of the rest of the lobe.

The hinder end of the plastron is usually, but not always, notcht.

At the anterior ends of the bridges the hyoplastron of each side sends upward a process, the axillary buttress, which articulates with the first costal plate. Usually this buttress does not pass above the lower border of the costal. At the hinder end of the bridge the hypoplastron sends up an inguinal buttress, which also rarely rises above the lower border of the costals involved. In *Gopherus* and the species of *Testudo* already mentioned this buttress is articulated with the middle of the lower border of the sixth costal; but it appears that in some other living genera of the family, possibly in some other species of *Testudo*, the buttress is attacht somewhat further forward. In *Hadrianus corsoni* the buttress ascends a short distance on the inner side of the sixth costal. In *Stylemys nebrascensis* it is articulated between the fifth and sixth costals, rising a short distance above their lower borders. It is evident that there has been a tendency among the Testudinidæ to push the buttress backward, and thus increase the width of the bridge. The purpose has apparently been to diminish as much as possible the hinder opening of the shell.

The shoulder-girdle of the Testudinidæ appears to be distinguisht from that of the Emydidæ in two respects: The coracoid is greatly expanded at its inner, or mesial border, and the procoracoid process makes an obtuse angle with the body of the scapula. Probably in all Emydidæ the coracoid is only slightly expanded at the mesial border and the procoracoid process makes an acute angle with the body of the bone.

The humerus, in probably all members of the family, is characterized by having the radial and ulnar processes both twisted toward the ventral side of the bone, thus making the angle between them small. Usually the humerus is considerably bent, but often no more so than in some species of Emydidæ.

In most species of the family there are 5 digits belonging to each forelimb; but occasionally there are only 4. No digit possesses more than 2 phalanges. How this reduction has been brought about is an interesting question. A similar reduction of the phalanges to two in each digit occurs in the forefoot of *Terrapene* as observed by Dr. George Baur (Zool. Anzeiger, xv, 1892, p. 159).

The metacarpal bones are very short, usually broader than long. The whole foot is short and heavy, resembling that of an elephant.

The pelvis is constructed on the plan of that of the Emydidæ.

The femur is distinguisht from that of the Emydidæ in the union of the two trochanters by a ridge which runs nearly on the level of the head of the bone, when the femur is held perpendicularly. Between this ridge and the head there is a pit of some depth. The metatarsals and the phalanges are not so short as the corresponding bones of the forelimb; but they are much shorter than those of the Emydidæ. There are only 4 digits, the fifth metatarsal being reduced to a rudiment. No digit has more than 2 phalanges.

Little is known regarding the feet of *Hadrianus*, but we may confidently expect to find only 2 phalanges in each digit. While the structure of the digits of *Stylemys* is not certainly determined all the known facts point to conditions similar to those found in the other genera of the family.

The most striking differences between the skulls of the Testudinidæ and those of the Emydidæ are found in the excavation of the roof of the mouth of the members of the former family and in the closure of the stapedial notch. The palate rises high above the level of the crushing-surfaces of the upper jaws and the vault thus formed is carried back to between the quadrates. The skull of *Hadrianus* is wholly unknown. The skull of *Stylemys* presents the same vaulting as that of *Testudo*.

The geographical distribution of the Testudinidæ (fig. 14, p. 33) within historical times is a most important and interesting question, and it has within recent years provoked much discussion. Dr. Albert Günther (Proc. Linnean Soc. Lond., CX, 1898, p. 26), as an appendix to his presidential address on this subject, has given a list of 51 papers which have a bearing on the question. The most difficult question to settle is how the ancestors of the gigantic tortoises which once abounded on the Galapagos Islands and on various groups in the Indian Ocean reacht those islands. Originally it was assumed that these ancestors were accidental arrivals, borne thither by oceanic currents; but in 1891 Dr. George Baur (Amer. Naturalist, XXV, pp. 217-229; 307-326) promulgated the theory that these islands were only the volcanic peaks of a great tract of land which had at one time connected these islands with one another and with the western coast of America. In a number of papers succeeding this announcement he defended this theory. For Dr. Baur's views the reader is referred to his writings, a list of which was publisht by Dr. W. M. Wheeler in 1899 (Amer. Naturalist, XXXIII, pp. 23–30).

The present writer does not intend to enter upon a full discussion of the question, but he records it as his conviction that in general terms Dr. Baur's position is correct. Probably the simplest way to account, on the old theory, for the presence of these tortoises on these remote islands is to suppose that, some time in the distant past, a gravid female was borne by currents, swimming or floating on a raft of fallen timber; that she landed on one of the islands; and that her descendants were in some similar way distributed to the other islands of the group. But these Testudinidæ are probably of all turtles the least adapted for such transportation. In the water they would almost certainly drown within a few hours. Nor is it probable that a raft of wood would hold together long enough or well enough to carry one of these turtles, wholly incapable of clinging to such objects, the distance of 700 miles. If this almost miracle of transportation had been accomplisht, it must have been repeated on a smaller scale many times, in order to populate the various islands. And all this work must have been accomplisht long ago, and long ago have ceast; have been accomplisht long enough ago to permit the evolution of a distinct species on each island, and have ceast long enough ago that new arrivals should not have disturbed this differentiation. It is difficult to imagine why the distribution of these turtles between the various islands should not have continued, if it had ever been possible.

Probably the chances for lizards to reach the Galapagos Islands from the American coast and from one island to the other are much better than those favoring the turtles. Yet we find the same variation among the lizards of the islands that we find among the turtles. Four genera are represented on these islands, of which two, *Tropidurus* and *Phyllodactylus*, are represented on the American coast. Two others, *Conolophus* and *Amblyrhynchus*, are peculiar to the islands in question. It seems that the opportunities for the accidental transportation of lizards are to-day as good as they could ever have been, yet no species are common to the American coast and the Galapagos Islands. We would be justified in expecting something

more than a few common species. Along the western coast of Central and South America, in situations where they are liable to be carried down by rivers to the Pacific Ocean, there live about 50 genera of lizards. How can it be explained that such a fragment of these has reacht the Galapagos Islands?

An instructive chart, publisht by Dr. Alexander Agassiz (Bull. Mus. Comp. Zool., XXIII, pp. 56–74, plate iii) exhibits the floor of the ocean in that region, and demonstrates the presence of a tongue of uplift which extends from the Galapagos Islands to the Central American coast just north of the Gulf of Panama. It seems therefore probable that at some time in the past, evidently after the Oligocene, more probably during the Miocene, there existed a mass of land which included the Galapagos Islands and joined narrowly the Central American coast. This land mass might be compared to the island of Madagascar, with the long axis at right angles with the neighboring continent, instead of parallel with it. Over the narrow bridge there past the ancestors of the present turtles of those islands and a few genera of lizards, together with some other animals and sundry plants. The descendants of these invaders have differentiated and formed a part of the present fauna and flora of the islands. It is not unlikely that some genera which invaded that land perisht afterwards.

When we try to account for the presence of the gigantic tortoises found at one time, but now nearly extinct, on the islands of the Indian Ocean, we are met with the same difficulties that we have been considering. If the conformation of the land and sea was the same as now when the ancestors of these tortoises reacht their island homes, they must have been transported over the seas for distances varying from 250 to 750 miles.

The solution of the various problems connected with the distribution of animals and plants in southern Africa and southern Asia and the islands of the Indian Ocean have driven many geologists, zoologists, and botanists to the conclusion that at one time there was a land connection between India and South Africa, across the Indian Ocean. For a masterly discussion of this question the reader is referred to the presidential address of Mr. W. T. Blanford before the Geological Society of London in 1896 (Quart. Jour. Geol. Soc. Proc., p. 98), and also to Günther's address already cited. Blanford concludes that there was such a land connection as has been mentioned above, that this continued thruout the Upper Cretaceous, and was broken up into islands at an early Tertiary date. Dr. Günther adopts this conclusion and adds that "the slow evolution of this chelonian type (*Testudo*) which has scarcely changed since the Eocene, and its wide distribution over the Northern Hemisphere, justify the supposition that it was in existence already before the Tertiary, before the bridge was broken through which allowed of its passage southwards or northwards."

That primitive Testudinidæ were in existence toward the close of the Upper Cretaceous is very probable, but that the genus *Testudo* had at that time made its appearance there is no proof, no probability. We do not know of its existence with certainty before the Upper Eocene in Africa and the lowest Oligocene in America. The less advanct forms of the family, as *Hadrianus* and related genera, may have reacht India or South Africa by the end of the Cretaceous, but we have no evidence of this. Hence, unless we are willing to betake ourselves to what ought to be our last refuge and hold that *Testudo* had a polyphyletic origin (using this term in its original sense), that the Testudos of America and those of the eastern continents sprang independently from *Hadrianus* or from the latter genus and another, we must place at a later date than the early Eocene the arrival of the ancestors of the gigantic tortoises on Madagascar and the islands of the western portion of the Indian Ocean.

The conclusion reacht by Mr. Richard Lydekker regarding the time of separation of Madagascar from the mainland was that this occurred during the Miocene (Geog. Hist. Mammals, p. 223). Mr. Blanford had previously concluded that the depression of 1,000 fathoms or more which led to the formation of the Mozambique Channel had taken place during Pliocene or Postpliocene times. However, the recent discovery of species that can hardly be separated from *Testudo*, in the Fayum in Egypt, makes it necessary to recognize the fact that members of the genus had reacht that continent as early at least as the Upper Eocene.

Testudinidæ at their various stages of development are known at earlier dates in North America than elsewhere. It seems therefore probable that North America was their center of distribution. From western North America they may be supposed to have reacht Central America and to have migrated thence to the present Galapagos Islands. From western North

America, taking a northwestern direction, they past into Asia over the bridge of land which occupied the position of Bering Strait. Passing westward they entered Europe. Others spreading southwestward peopled India and the strip of land which connected the latter country with Africa, and which now, greatly deprest, is represented by Madagascar and various groups of islands. From this land they entered Africa itself.

The living Testudinidæ which have been designated as "gigantic tortoises" all belong to the genus *Testudo*. The species of *Hadrianus* of the Eocene were worthy of being called gigantic. That the gigantic forms, living and extinct, may, in some cases, have been derived from small species and that some of the smaller modern species are the descendants of extinct gigantic ancestors, are possibilities. Within historical times gigantic tortoises have lived only on islands, where there are no large carnivorous mammals. On the other hand, the large Testudinidæ of North America, from the Lower Eocene to the Pliocene, were exposed to the attacks of large carnivora.

As remarkt by Mr. R. Lydekker, the gigantic tortoises became extinct on all the continents at the close of the Pliocene. This appears to be true of North America, since the 3 species

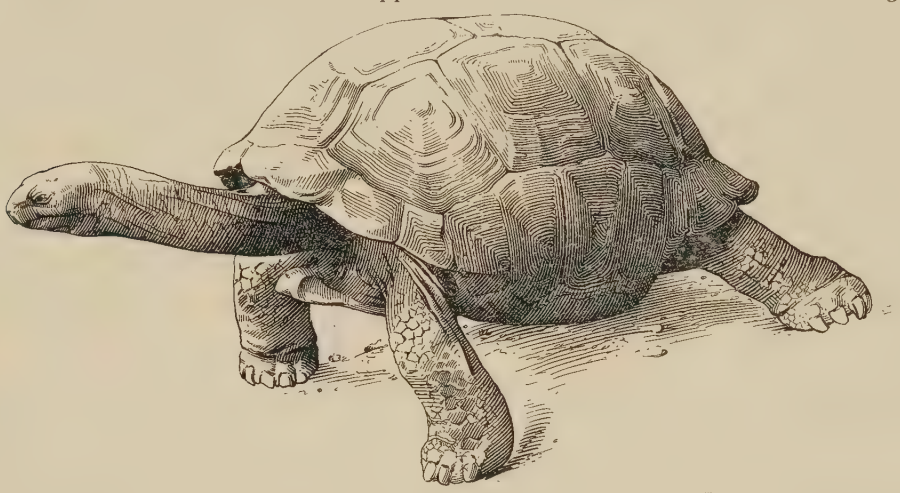


FIG. 471.—*Testudo sumeirei*. View of living animal. After Rothschild's figure, greatly reduced.

recorded from the Equus beds are all of moderate size. Nevertheless, Dr. Leidy has figured the claw phalange (Cont. Extinct Vert. Fauna West. Terrs., 1873, pl. xxxiii, fig. 21) of a species of *Testudo* found in Pleistocene deposits in Hardin County, Texas. The individual must have been one of great size. This phalange is now in the American Museum. We do not know why some of the Pliocene gigantic tortoises should not have had descendants in the Quaternary worthy of accompanying the great mammals of that period.

Fig. 470 represents *Testudo sumeirei* Sauzier, a gigantic tortoise living in Port Louis, Mauritius. This figure is reproduced from a plate publisht by the Hon. Walter Rothschild (Novitates Zoologicæ, I, 1894, plate xi) over the name *Testudo indica*. This tortoise was mentioned in a treaty made in 1810. The length of the carapace is 40 inches (1015 mm.); that of the plastron, 28 inches (711 mm.).

Analysis of Genera.

A. Epiplastral lip projecting abruptly from front of carapace.
- *a*. Neural bones hexagonal. Eocene species ..... *Hadrianus*
- *aa*. Usually some octagonal and quadrangular neurals; Oligocene to Recent species ... *Testudo*

AA. Epiplastral lip not projecting abruptly or far beyond gulo-humeral sulci.
- *b*. Epiplastral lip not thickened backward above; Bridger ..... *Achilemys*
- *bb*. Epiplastral lip thickened backward above; Oligocene ..... *Stylemys*

Genus HADRIANUS Cope.

Testudinidæ with the plastron extensively united to the carapace by suture; with short axillary and inguinal buttresses, the latter of which ascend within the sixth costal plates; no plastral hinge. Epiplastral lip strongly developt; entoplastron wholly in front of the pectoral

scutes; hinder lobe of plastron notcht. Of the neural plates the second and third are hexagonal with the shortest sides directed backward; the third is quadrilateral; and the remainder are hexagonal, with the shortest sides directed forward. Three suprapygals, of which the penultimate is notcht behind and receives the third. Costals with no great difference between the widths of the proximal and distal ends. Two supracaudal scutes. Shoulder and pelvic girdles as in *Testudo*. Skull unknown. Cervical vertebræ and limb bones not well known.

Type: *Testudo corsoni* Leidy.

Without having the skull and the distal limb bones, it is not possible to say positively that this genus belongs to the Testudinidæ, as limited in this work. The shell and shoulder and pelvic girdles, however, present many characters which indicate close relationships with the modern land-tortoises. We find in this genus apparently the beginnings of those modifications of the shell which characterize the genus *Testudo*. In most species of the latter the neural plates are alternately tetragonal and hexagonal; and the second, fourth, and sixth costals are narrow at the proximal ends and wide at the distal ends, while the third, fifth, and seventh are wide proximally and narrow distally. In *Hadrianus* the third neural is quadrate, as in *Testudo*, and the corresponding costals are widened proximally to come into contact each with three neurals also, as in *Testudo*. The other costals differ only slightly in the widths of their opposite ends. As in *Testudo*, the connection between the costals and the peripherals is a rather loose one; the sulcus between the costal and marginal scutes follows closely the sutures between the peripheral and costal bones; the epiplastrals form a conspicuous lip; the humero-pectoral sulcus falls behind the entoplastron; and the pectoral scutes are rather narrow. Even *Stylemys*, belonging to a later period, appears to be less advanct in many respects than *Hadrianus*.

In various writings (the latest being his Vertebrata of the Tertiary Formations of the West, 1884, p. 113) Prof. E. D. Cope assigned as the character distinguishing *Hadrianus* from the other Testudinidæ a divided supracaudal scute. Three species of the genus *Testudo*, as recognized by Boulenger, also have this scute divided. It seems to the author that the undifferentiated condition of the shell furnishes a more satisfactory basis for the genus. Mr. Richard Lydekker (Cat. Foss. Rept. and Amphib. Brit. Mus., III, p. 72) gives, among other characters distinguishing *Hadrianus*, the "narrow vertebral shields and the elongated neural bones which are hexagonal, with short postero-lateral surfaces" [sides]. The neurals, however, are not of unusual narrowness. As to their form, Mr. Lydekker cites a figure by Leidy which represents only the 3 anterior neurals, but another figure by Leidy in the same work (Ext. Vert. Fauna West. Terrs, plate xxx, fig. 1) shows that the fourth and fifth neurals have the antero-lateral sides short.

So far as known at present the members of this genus are confined to the Eocene. The oldest-known species is *H. majusculus* Hay from the Wasatch of New Mexico; the most recent species is *H. tumidus* Hay, from the Upper Uinta. As suggested by Mr. Lydekker, some of the Eocene and Miocene species of Europe that have been referred to *Testudo* may in reality belong to *Hadrianus*.

Analysis of the Known Species.

1. Wasatch. Very high peripherals. Pectoral scutes more than half as wide along midline as the abdominals ..... *majusculus*
2. Bridger. Peripherals of moderate height. Pectoral scutes less than half as wide on midline as the abdominals ..... *corsoni*
3. Uinta. Peripherals high. Pectoral scutes less than one-third as wide as the abdominals .. *tumidus*
4. Jackson formation. Pectoral scutes one-ninth as wide as the abdominals ..... *schucherti*

Hadrianus majusculus Hay.

Plate 59, fig. 1; text-fig. 472.

?Hadrianus corsonii, Cope, Syst. Cat. Vertebrata Eocene N. Mex., 1874, p. 36; Append. LL. Ann. Rep. Chief Engineers (Wheeler's Surv.), 1875, p. 1016 (separata, p. 96)

Hadrianus majusculus, Hay, Amer. Jour. Sci., (4), XVIII, 1904, p. 271, plate xv; text-fig. 5.

The species here described is founded on a somewhat damaged shell which belongs to the Marsh collection in Peabody Museum, at Yale University. Accompanying this shell is a label which bears the following record: "Turtle from foot of bluff, west side of Murderer's Gap.

In large fragment of sandstone that had fallen from the bluff. Nov. 19, 1876. ·D. Baldwin." Another label states that the specimen came from the "Eocene Bad Lands, Gallina, New Mexico." This locality appears to be in Rio Arriba County, of the territory mentioned. The deposits whence the shell was derived are in all probability a portion of the Wasatch. On the carapace is found Professor Marsh's receipt number 927.

The specimen is somewhat distorted and injured by pressure, being slightly comprest and thrust toward the left side. Crushing has also affected the upper median region, so that most of the neurals have been displaced. At a later time these were weathered and fractured; and it is now quite impossible to restore them to their proper positions. The right border from the fifth peripheral to the tenth has been weathered and removed. In the same way the right side of the hinder part of the plastron has been damaged.

The length of the carapace (plate 59, fig. 1) in a direct line is 530 mm. The greatest width was at least 440 mm. In form it was high and archt. Over the limbs the peripherals were considerably flared. The anterior border was truncate; the hinder border rounded and scallopt. The free borders of all the anterior and posterior peripherals have acute edges.

On account of crushing the dimensions of the nuchal bone can not be determined. Apparently it extends backward but little further than the first peripheral. While portions of most of the neurals remain, little regarding them can be said. The seventh has a length of 40 mm. The eighth is small. There are apparently 3 suprapygals. Of these the anterior appears to have been 23 mm. long and to have had an anterior concave and a posterior convex border. The second suprapygal is bifurcate, with the lateral branches resting on the eleventh peripheral. The third suprapygal is lozenge-shaped and is included between the branches of the second suprapygal bone and the pygal. The costals vary considerably in width; but unlike those of the species of *Testudo*, the upper and the lower ends differ little in width. The table herewith gives the dimensions of the costals, excluding the first.

Costal.	Width proximally.	Width distally.
2	62	77
3	45	50
4	72	70
5	46	44
6	45	45
7	30	40
8	35	55

The peripherals are large, those of the bridge region rising much higher than in *H. corsoni*. The first and second each occupy about 80 mm. of the free border of the carapace and extend backward from the border 72 mm. Those of the bridge region rise a distance of 90 mm. above the slight carina which runs from the free edge of the third peripheral to the edge of the seventh. The eleventh peripheral rises 70 mm. from the free border. The pygal is 45 mm. high in the midline; 62 mm. wide at the upper border; and 40 mm. wide at the lower border. The upper border is notcht for the lower border of the hindermost suprapygal.

The sutures between the bridge peripherals coincide at their upper ends closely with those between the costals, except that between the fourth and fifth peripherals. The sutures between the bridge peripherals and the plastral bones appear to have been obliterated.

The sulci between the dermal scutes of the carapace are narrow and shallow, but most of them lie in rather deep grooves in the bones. Of the vertebrals none can be satisfactorily mapt, except the fifth. This is about 150 mm. wide behind. Its anterior border appears to have crost the eighth neural. It is probable that the others were narrow. The sulci between the costal scutes and the marginals follow closely the sutures between the costal and the peripheral bones, except that in front the sulci lie on the nuchal and the first and second peripheral bones; while in the rear the sulcus crosses from side to side the hindermost suprapygal. There are two very distinct supracaudal scutes, a right and a left.

The total length of the plastron (fig. 472) was about that of the carapace, 530 mm. The anterior lobe extends somewhat in front of the anterior border of the carapace, and has a length of 180 mm. The width was at least 266 mm. There is a rather prominent lip, which projects beyond the general border of the lobe. This lip is truncated, or only slightly rounded in front. The width at the base is 120 mm., in front about 88 mm. The free borders of the lobe are subacute, but the front of the lip is considerably thickened. On the upper side the thickening increases until it is 33 mm. There is on this upper surface a median ridge, on each side of which is a longitudinal valley.

The entoplastron appears to have been of the same form as in *H. corsoni*. Its length is 80 mm., its width 120 mm. The length of the bridge is 206 mm.

On account of lateral crushing the width of the posterior lobe can not be accurately determined. Its length is 175 mm. It is conspicuously notcht behind, the depth of the notch being 45 mm.

The gular scutes probably overlap slightly the entoplastron, but this is not certain. The humero-pectoral sulcus skirts the hinder border of the entoplastron. The pectoral scutes have a form quite different from that of *H. corsoni*. They are narrow just mesiad of the axillary notch, but grow wider as they approach the midline, attaining there a width of 75 mm. At the midline the abdominals have a fore-and-aft extent of 140 mm., the femorals 80 mm., the anals about 55 mm. The sulci of the plastron are rather narrow and shallow, but those of the bridge lie in deep grooves.

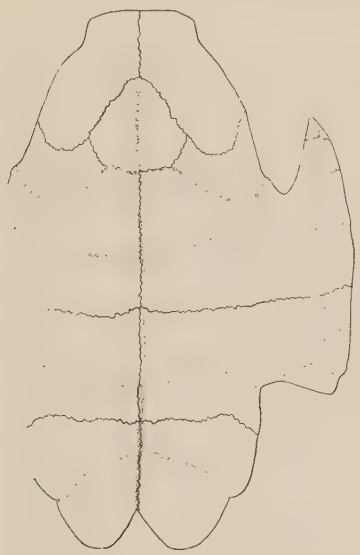


FIG. 472.—*Hadrianus majusculus*. Plastron of type. $\times \frac{1}{8}$.

This species differs from *H. corsoni* in several respects. The most conspicuous is perhaps the height of the peripherals, especially those above the bridges. The form and width of the pectoral scutes too is distinctive. The bridge appears to be shorter in comparison with the length of the anterior lobe. The hinder borders of the carapace are more scallopt than in *H. corsoni*.

Prof. E. D. Cope referred some remains of *Hadrianus* from the Wasatch of New Mexico to *H. corsoni;* while other remains he regarded as a distinct species, which, however, he did not name. His specimens appear to be lost. It is doubtful whether any of them belonged to the Bridger species.

Hadrianus majusculus is interesting because of the fact that it is the oldest-known representative of the family Testudinidæ.

Hadrianus corsoni (Leidy).

Plates 60, 61; text-figs. 473–479.

Testudo corsoni, LEIDY, Proc. Acad. Nat. Sci. Phila. 1871, p. 154; U. S. Geol. Surv. Montana, etc., 1872, p. 366; Proc. Acad. Nat. Sci. Phila. 1872, p. 268; Contrib. Extinct Vert. Fauna West. Terrs., 1873, pp. 132, 339, plate xi, figs. 1, 2; plate xv, fig. 7; plate xxix, figs. 2–4; plate xxx, figs. 1–4.

Emys carteri, LEIDY, Proc. Acad. Nat. Sci. Phila. 1871, p. 228; Amer. Jour. Sci., (3) II, 1871, p. 372; U. S. Geol. Surv. Mont., etc., 1872, p. 367; Contrib. Ext. Vert. Fauna West. Terrs., 1873, pl. xi.

Testudo hadrianus, COPE, Palæont. Bull. No. 1, 1872; Proc. Amer. Philos. Soc., XII, 1873, p. 463.

Hadrianus quadratus, COPE, Proc. Amer. Philos. Soc., xii, 1873, p. 468.

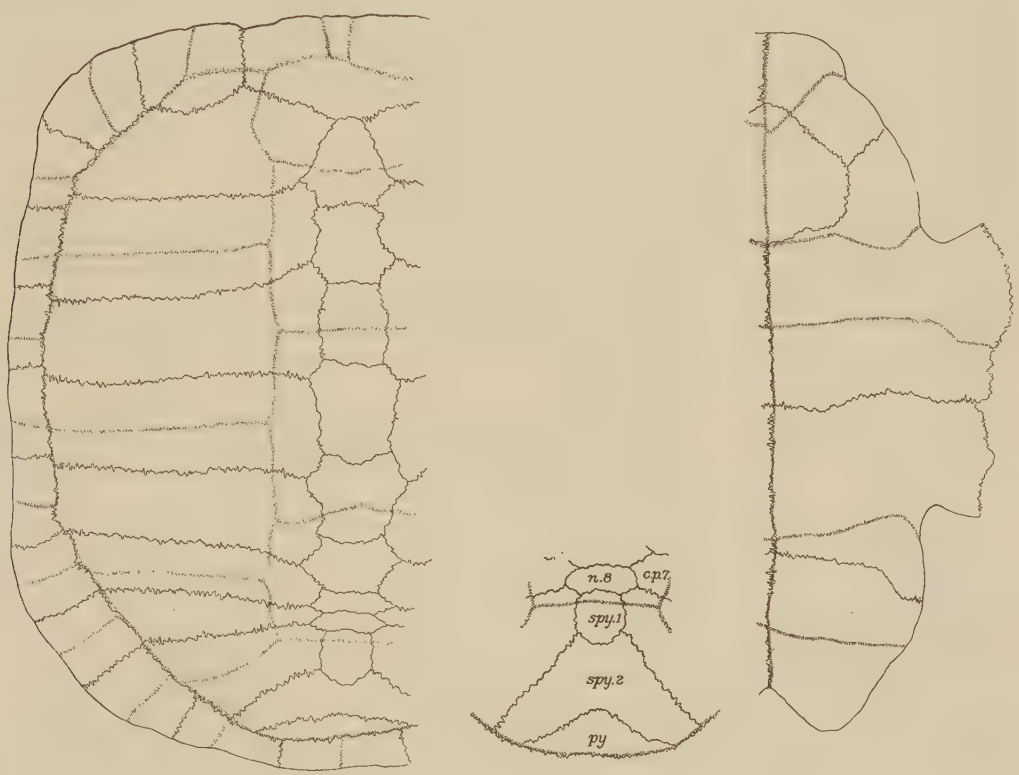
Hadrianus octonarius, COPE, Palæont. Bull. No. 2, 1872; Proc. Amer. Philos. Soc., XII, 1873, p. 468; U. S. Geol. Surv. Terrs., 6th. Ann. Rept., 1872 (1873), p. 630; Amer. Naturalist, XVI, 1882, p. 992, figs. 11–13; Vert. Tert. Form. West. 1884, p. 140, plate xx, figs. 1–4.—OSBORN, SCOTT, and SPEIR, Pal. Rept. Princeton Sci. Exped. 1877, p. 95.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 450.

Hadrianus corsoni, COPE, U. S. Geol. Surv. Terrs., 6th. Ann. Rept., 1872 (1873), p. 631; ?Syst. Cat. Vert. Eocene N. Mex., 1873, p. 36; ?Ann. Rept. Chief Engineers, Explor. W. 100th Merid., 1875, p. 1016 (of separata, p. 96); ?Wheeler's Rept. U. S. Geog. Surv. W. 100th Merid., IV, 1877, p. 58, plate xxiv, figs. 36, 37; Amer. Naturalist, XVI, 1882, p. 992; Vert. Tert. Form. West, 1884, p. 141.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 450; Amer. Geologist, XXXV, 1905, p. 333.

This species was based on the anterior portion of a plastron which was discovered by Dr. Corson at the Grizzly Buttes, about 15 miles south of east of Fort Bridger, Wyoming, and which was sent for study to Dr. Leidy. This was figured by the latter author in his Contributions to the Extinct Fauna of the Western Territories, plate xv, fig. 7, and is in the Academy of Natural Science, at Philadelphia. In 1871 Dr. Leidy made a trip to Fort Bridger and obtained a number of specimens of the same species, and these added much to the knowledge of the animal. Among the remains secured was a large plastron which, on account of post-mortem injury to the lip, Dr. Leidy did not recognize and which he made the type of the species

Emys carteri. A still larger and nearly complete plastron was correctly identified; likewise a portion of a carapace of another individual, including the neurals and the proximal portions of most of the costals. Some of the materials obtained by Dr. Leidy exemplify the great variation found in the form of the anterior lip. Professor Cope in the same year, 1871, discovered several specimens which he recognized as belonging to Leidy's species; but he gave no extended description and no figures. Under the name *Hadrianus octonarius* he described and figured a large and nearly perfect shell which is now in the U. S. National Museum. For reasons given below this is referred by the present writer to *H. corsoni.*

Besides the specimens described by Dr. Leidy and Professor Cope, a number of other well-preserved shells have been discovered. One of the largest of these is now in the museum of



473. 474. 475.

FIGS. 473–475.—*Hadrianus corsoni.* Carapace and plastron. $\times\frac{1}{6}$. No. 6027 A. M. N. H.

473. Carapace.
474. Rear of carapace. *c. p.* 7, seventh costal; *n.* 8, eighth neural; *spy,* 1, *spy.* 2, first and second suprapygals; *py,* third suprapygal.
475. Plastron.

Princeton University, and will be referred to again. During the summer of 1903 the American Museum expedition to the Bridger Eocene, in the region east of Fort Bridger, collected 3 more or less complete turtles of this species. One of these, No. 6027, furnishes the following description:

The plastron is almost wholly uninjured. The carapace lacks a little of the anterior margin, some portions of the bridge peripherals, the pygal, a part of the eleventh peripheral, and the right peripherals behind the axillary notch, except the tenth and a part of the eleventh. The shell appears not to have suffered any considerable depression during fossilization.

The length of the carapace (plate 60; text-fig. 473) in a straight line from the front to the rear is 590 mm.; its greatest width close to 455 mm.; its greatest height, which is toward the rear, 215 mm. The border in front is between rounded and truncate; behind, the outline is broadly rounded. The peripherals over the limbs are slightly flared; the pygal region seems

to have sloped steeply. The carapace is broadly archt along the median line and more sharply archt from side to side.

The nuchal bone occupied 100 mm. of the free border; its maximum width is 120 mm.; and its length is 110 mm. The neurals agree very closely with those of Leidy's plate xxx, fig. 1, of his Contributions. Not one is octagonal. The first is clavate; the second is hexagonal, and comes into contact with both the second and the third pairs of costal plates; the third is quadrilateral and in contact with the third pair of costals only. The succeeding neurals are all hexagonal, and each is in contact with the corresponding pair of costals and with the pair immediately in front. The anterior four neurals are longer than broad; the posterior four are broader than long.

Behind the neurals is a series of 3 suprapygals (fig. 474). The first, or most anterior, is 42 mm. long and 34 mm. wide. It is in contact with the eighth pair of costals. The second suprapygal is bifurcate, as in *Testudo*, and the forks rest on the eleventh peripherals. The third suprapygal is triangular, with a straight and broad base, and lies between the forks of the second suprapygal. It is evident that there were three suprapygals in the specimen represented by Leidy, plate xxx, fig. 1, of his Contributions, etc.

The costals display only the earliest stages of the differentiation seen in the genus *Testudo*. Only those of the third pair articulate with 3 neurals. The table herewith presents the widths of the upper and lower ends. Most of the costals are crost by low ridges, which mark the stages of growth of the dermal scutes.

Costal.	Width upper end.	Width lower end.
1	67	78
2	65	79
3	78	56
4	74	67
5	63	51
6	44	50
7	27	56
8	40	72

The peripherals are relatively low, as compared with those of most species of the genus *Testudo*. Those of the bridge have a height of about 80 mm., as do also those of the axillary and inguinal regions.

The vertebral scutes are of moderate width and have straight sides. The first, second, and fourth are each 106 mm. wide; the third, 111 mm.; the fifth, 179 mm. at its hinder end. The first vertebral is 80 mm. wide at the anterior end. The nuchal scute is 40 mm. long and about 17 mm. wide. The sulcus between the marginal scutes and the costals follows closely the suture between the underlying bones, except that it crosses the first peripheral some distance below its upper border.

The plastron (plate 61; text-fig. 475) has an extreme length of 550 mm. The anterior end projects about 35 mm. in front of the carapace. The central parts of the plastron are somewhat concave. The anterior lobe is 175 mm. long and 246 mm. wide at the base. The free borders are acute. The anterior lip projects slightly beyond the general contour of the lobe, and 35 mm. beyond the line joining the points where gulo-humeral sulci cross the free border. Between these points the lip is 118 mm. wide. On its superior surface the lip extends backward 75 mm. The upper surface is slightly convex from side to side; the lower surface is nearly flat. The anterior outline is rounded.

The entoplastron is narrow in front and broad behind. The length in the median line is 115 mm.; the greatest breadth, 134 mm.

The length of the posterior lobe is 157 mm.; the width at the base, 240 mm. The width of the posterior notch is about 80 mm.; the depth, 30 mm. The fore-and-aft extent of the bridge is 215 mm. The free edges of this lobe are acute. At the inguinal notch the border of the hypoplastron is 36 mm. thick. From the summit of the wall thus formed the bone slopes to the free edge at an angle of about 45°.

The gular scutes encroach somewhat on the entoplastron. The humero-pectoral sulcus is tangent to the entoplastron behind. The pectoral scutes meet along the midline about 62 mm.; the abdominals, 163 mm.; the femorals, 73 mm.; the anals, 43 mm.

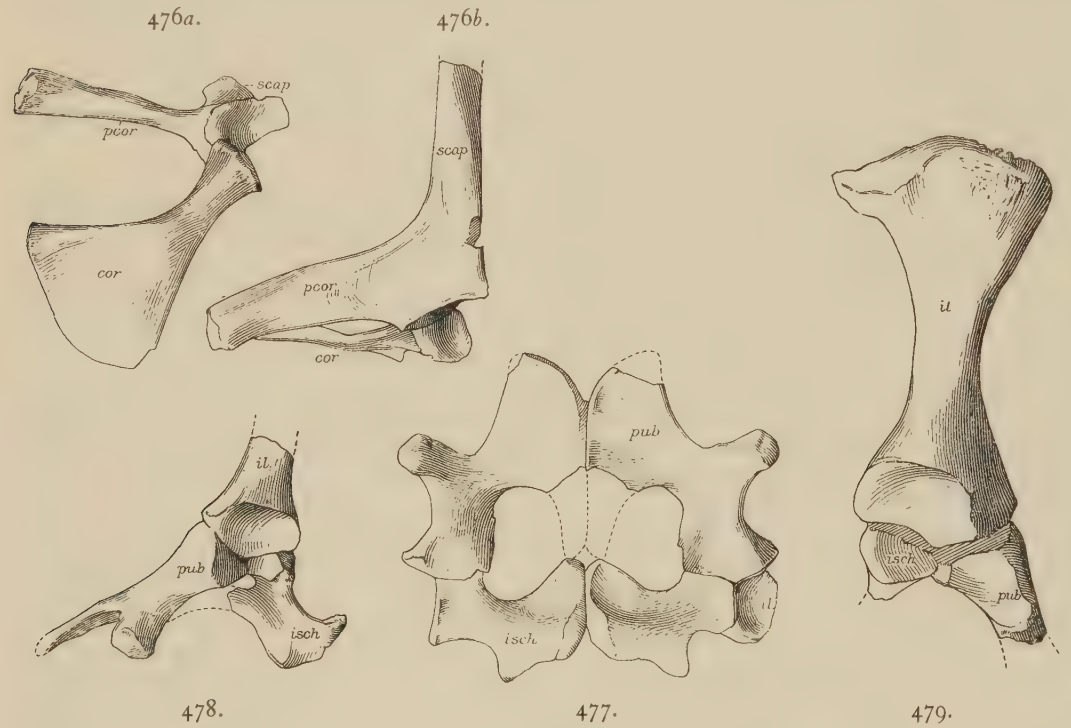
A specimen in the American Museum of Natural History, No. 1068, belonging to the Cope collection, having a plastron 410 mm. long, agrees well with the preceding description. However, the anterior vertebral scute is urn-shaped, with an anterior width of 44 mm. and a posterior width of 85 mm.

Another shell obtained by the American Museum expedition of 1903, No. 6026, has a length of 700 mm. The carapace is badly fractured and some portions of it are missing. The

sutures are so fine that it is not easy to trace them. The nuchal scute is extremely narrow; the supracaudal is divided at the midline. The peripherals over the limbs are considerably flared, but the pygal is nearly perpendicular. The plastron is more concave than in the specimen here first described. Also the lip is more truncate in front. The pectoral scutes are only 48 mm. wide at the midline. The notch in the hinder end of the plastron is 150 mm. wide and 46 mm. deep; being thus much wider than in the specimen here first described. The apices on each side of the notch are rather narrow and pointed.

No. 5958 of the same museum was collected in 1903. It has a length of 720 mm. The plastral lip has the form shown in the figure of Cope's *H. octonarius* (Vert. Tert. Form. West, plate xx), having parallel sides and a truncated front. The notch and the apices also resemble those of Cope's *H. octonarius*. The entoplastron is damaged, so that its form can not be determined. The shell is considerably crusht laterally.

No. 10082 of the Museum at Princeton University was collected at Smith's Fork, in southwestern Wyoming, in 1878. It has been regarded as being *H. octonarius*. Its length is 790 mm.;



FIGS. 476–479.—*Hadrianus corsoni*. ×½.

476. Scapula and coracoid. No. 1068 A. M. N. H. *a*, seen from below; *b*, seen from in front. *cor*, coracoid; *pcor*, procoracoid process; *scap*, scapula.
477. Pelvis seen from below. No. 1068 A. M. N. H. *il*, ilium; *isch*, ischium; *pub*, pubis.
478. Pelvis seen from left side.
479. Right ilium of large individual. No. 6026 A. M. N. H.

its width, 635 mm.; its height, 305 mm. The shell is nearly complete. The carapace is convex transversely but rather flat on the middle line. From front to the rear it is convex with the pygal region quite steep. The front and rear are somewhat truncate. All the peripherals are acute-edged. The sutures bounding the neurals are so fine that they have not been determined. The first vertebral scute is 62 mm. wide in front, 135 mm. wide behind, thus differing from that of other specimens in being very narrow in front. The second is 135 mm. wide; the third, 144 mm.; the fourth, 163 mm.; the fifth, 270 mm. The nuchal is 48 mm. long and 36 mm. wide.

The plastron has a length of about 775 mm. It is very concave, and has probably been that of a male. The lip projects about 80 mm. beyond the front of the carapace. It is large and of rather unusual form. The width at the base is 113 mm. but it expands toward the front

to 132 mm. There is a slight notch in the midline, and the lateral angles are rounded off. The notch in the hinder lobe of the plastron is 55 mm. deep. The humero-pectoral sulcus falls about 18 mm. behind the entoplastron. The pectoral scutes are 55 mm. wide at the midline.

It appears to the present writer that the specimen on which Professor Cope based his *H. octonarius* belongs really to *H. corsoni*. Cope states that the shell "is of an elongated form, strongly contracted at the bridge, but expanded and arched above the limbs." This narrowness of the fossil is deceptive, having, largely at least, been produced by distortion during fossilization. The right side is crusht inward from 50 mm. to 100 mm. and the hyoplastron and hypoplastron of one side have been pushed so as to overlap those of the other side. From the mesial border of the left hyoplastron at its hinder edge to the left outline of the shell is about 260 mm., which would make the width of the shell about 520 mm., instead of 437 mm., as given by Cope. This estimate makes the shell but little narrower than that of the specimen first described above, and this can hardly be regarded as *H. octonarius*. Cope has also stated that the entoplastron is heart-shaped; but this is an error, caused by not carefully distinguishing fractures from sutures. Its form is that seen in *H. corsoni*. The upper surface of the lip is concave, whereas in other specimens it is commonly convex or flat.

It is evident that there are great variations in the form of the lip and likewise in the size and form of the notch in the hinder lobe. Furthermore there appears to be no unvarying association of a large lip with a large hinder notch. It is therefore necessary to consider the various forms as belonging to a single species.

Professor Cope identified some fragments of turtles found in the Wasatch deposits of New Mexico, on Gallinas River, as belonging to *H. corsoni*. It is more probable that these materials belonged to the species which the present writer has named *Hadrianus majusculus*.

Portions of the internal skeleton of this species are rarely found. No skull has yet been secured. No. 1068 of the American Museum of Natural History, a half-grown individual collected by Cope, furnishes the greater part of both scapulæ, both coracoids, both ischia, both pubes, the acetabular end of one ilium, 2 phalanges, and 2 damaged cervical vertebræ.

Fig. 476 represents the scapula and coracoid of the left side, as viewed from below; it also shows the left scapula as seen from in front. It will be observed that the scapula is a stout bone, with more than a right angle between the body of the bone and the procoracoid process. Both the body and the process are comprest, except at the ends distal from the glenoid process. The coracoids broaden toward the mesial border, as in the genus *Testudo*.

Fig. 477 presents a view of the pelvis from below. The pelvis resembles more that of *Testudo*, especially that of *T. radiata* of Madagascar, than that of any of the Emydidæ at the writer's command. The lateral process of the pubis is placed mostly in front of the ischiopubic foramina. The section of the process is nearly circular in section. From the hinder border of each ischium there projects a pointed process. The extremities of these processes are distant from each other more than half the distance between the lower borders of the acetabula. In fig. 478 the pelvis is seen from the left side, a portion of the ilium being missing. Fig. 479 shows the right ilium of No. 6026 A. M. N. H. From its upper end there projects backward a sharp process, which received the outer ends of the two hinder sacral ribs.

The radius is a stout bone. All the bones of the shoulder-girdle and pelvis indicate an animal that was accustomed to bear its heavy body about on land.

One of the vertebræ present is the eighth cervical. It resembles closely that of *T. radiata*.

Hadrianus tumidus sp. nov.

Fig. 480.

The specimen on which this species reposes was obtained in the upper Uinta deposits of Utah, by the American Museum's expedition of 1895. Its number is 6076. It consists of nearly the whole of the left half of the plastron and the peripherals above the bridge. From the plastron are missing the epiplastron and the entoplastron. The parts present are in their natural relations, so that some idea may be obtained of the appearance of the shell.

The length of the portion of the plastron present (fig. 480), from the anterior end of the epiplastron to the extremity of the xiphiplastron, is 533 mm. The whole length of the carapace could then have been hardly less than 800 mm. The breadth of the half plastron, from the

midline to the lower ends of the peripherals, is about 220 mm. The extreme width of the carapace was about 550 mm. From a line joining the axillary and inguinal notches the bridge ascends at an angle of 30°, altho this may have been greater during life. About 130 mm. beyond the line mentioned there is an abrupt turn of the carapace upward. This continues, in our specimen, to the upper margin of the peripherals, a distance of 135 mm. The abrupt turn mentioned marks the position of a sharp carina which runs along the side of the shell from the free border of the carapace in front of the bridge to the free border behind it. Such a carina is seen in at least some specimens of *H. corsoni*. The width of the bridge is 250 mm.

The hinder half of the plastron was very concave, especially from the inguinal notches backward. The anterior half was flat. The individual was probably a male.

The bone of the central portions of the plastron is thin, 17 mm. just behind the entoplastron, in the midline; 9 mm. at the suture between the hyoplastrals and hypoplastrals; and 8 mm. at the anterior end of the xiphiplastrals. Near the free borders, however, the bone is very thick, 31 mm. at the anterior end of the epiplastron, 37 mm. at the anterior end of the xiphiplastron. On the epiplastron the bone is beveled off gradually to a sharp edge. Behind the inguinal notch the bone is beveled off very abruptly, so that the beveled portion is nearly perpendicular. The hinder end of the xiphiplastron is 32 mm. thick, rough, and with a broad, rounded edge.

FIG. 480.—*Hadrianus tumidus*. Plastron, lacking epiplastron and entoplastron. ×⅛. No. 2090 A. M. N. H

No part of the entoplastron is present, but the sutural border of the epiplastron enables us to determine something regarding its extent and form. It had a breadth of 156 mm. at the hinder ends of the epiplastrals. From a line joining these it has extended backward about 75 mm. From this we may infer that its larger portion lay behind the ends of the epiplastrals. It was not crost by the humero-pectoral suture. The anterior end of the hyoplastron, where it articulated with the epiplastron, is 55 mm. wide. The extreme length of the hyoplastron is 222 mm.; its length in the midline is 155 mm. The length of the hypoplastron in the midline is 140 mm.; on the line joining the axillary and inguinal notches, 173 mm. At the midline the xiphiplastrals measure 118 mm. At their anterior ends they are 140 mm. wide. The notch at the posterior end of the plastron has not exceeded 25 mm. in depth.

The suture between the plastron and the peripheral bones, on the bridge, runs a very sinuous course, the opposing bones forming broad interdigitations 35 mm. long. The fifth and sixth peripherals are each about 85 mm. wide, fore and aft, and rise about 135 mm. above the turn of the carapace upward.

The plastral buttresses of this species are rather weak, but are relatively better developt than in *Testudo*. They rise to the upper margin of the peripherals. The sulci are deeply imprest. The humero-pectoral begins just in front of the axillary notch, runs inward and backward for a short distance, then straight across the plastron, just missing the hinder border of the entoplastron. Behind this sulcus, 55 mm., the pectoro-abdominal sulcus crosses the midline. It is bent slightly forward on each side, then runs outward, backward, and upward to the marginal suture. The abdominal scutes have great extent. Along the midline they measure 193 mm. The sulcus limiting them posteriorly runs from the midline outward and somewhat forward, passing 50 mm. in front of the inguinal notch. The femoral scutes join along the

midline for the space of 85 mm. The sulcus between these and the anals is directed outward and backward. Where it crosses the edge of the xiphiplastron there is a considerable notch. The anals have a fore-and-aft extent of about 70 mm. and a breadth of 103 mm. each.

The sulcus between the plastral and the marginal scutes runs above the lower peripheral suture, as it does in *Testudo*.

There is a large inguinal scute, but there is no axillary scute, or a very obscure one.

On the bridge are three considerable bosses, separated by the sulci in front of and behind the abdominal scute.

In endeavoring to find characters to distinguish this species from the others that have been described we miss first the epiplastral lip. From *H. majusculus*, of the Wasatch, it differs in having the bridge longer relatively to the hinder lobe. In the Wasatch species the hinder lobe forms about 85 per cent. of the length of the bridge; in *H. tumidus*, only about 77 per cent. The pectoral scute of *H. majusculus* is broader than that of *H. tumidus*, and the anal notch is deeper.

From *H. corsoni*, of the Bridger beds, the Uinta species appears to differ in several respects. The peripherals over the bridges are evidently higher, the height in the former species amounting to considerably less than one-half of the width of the bridge, while in the Uinta species the height is equal to one-half of the bridge. In *H. corsoni*, from the inguinal buttress a broad ridge runs backward to the rear of the hinder lobe at the midline. Mesiad of this, the upper side of the plastron is concave, especially next to the ridge. Outside of the ridge the surface is beveled off, near the buttress steeply, but less and less so more posteriorly, until on the posterior outer angle of the xiphiplastron the slope is very gentle. In *H. tumidus* this ridge is almost wholly obsolete and the upper surface of the posterior lobe is convex to near the border, then pitches off nearly perpendicularly. This condition continues to the notch for the anal sulcus. The hinder extremity of the xiphiplastron of *H. corsoni* is thinned off to a sharp edge while in *H. tumidus* it is thick and the free edge is rounded off.

Hadrianus? schucherti Hay.

Text-fig. 481.

Hadrianus schucherti, Hay, Proc. U. S. Nat. Mus., xxii, 1899, p. 22, plates iv, v; Bibliog. and Cat. Foss. Vert. N. A., 1903, p. 450.—Schuchert, Proc. U. S. Nat. Mus., xxiii, 1900, p. 328.

The present species is assigned provisionally to the genus *Hadrianus*, altho it belongs possibly to *Testudo*. If really a *Testudo*, it is one of the oldest, if not the oldest of the genus, coming as it does from the Upper Eocene.

The type and only known specimen belongs to the U. S. National Museum. It was discovered by Prof. Charles Schuchert, then of the U. S. Geological Survey, in the Zeuglodon beds of the Jackson formation, near Cocoa post-office, in Choctaw County, Alabama. In the immediate vicinity Professor Schuchert found bones of the mammals *Basilosaurus*, *Dorudon*, and of the snake *Pterosphenus schucherti* Lucas.

The upper portion of the carapace of this specimen had been eroded away down to the upper borders of the peripheral bones. We are therefore unable to determine the characters of the neural and costal bones. Nor are we able to determine whether the supracaudal scute was single or double.

The total length of the carapace was originally close to 750 mm. Its width is 525 mm. As will be seen from an inspection of fig. 481, the lateral borders of the shell are nearly straight and parallel with each other. In front of the axillary notch the margins round rapidly into the anterior border. The shell is quite truncated in front. The hinder border approaches in form a segment of a circle. Neither the anterior nor the posterior border is to any degree serrated. The peripherals rise on the sides of the shell to a height of 100 mm. The passage of the lower surface of the shell to the upper is quite abrupt; but this appears to be due to a considerable extent to distortion by pressure.

The borders of the carapace over the opening for the hinder limbs are flared gently upward; over the openings for the forelimbs they are more strongly flared.

The plastron is concave, a condition that indicates a male individual. It has a length of 675 mm. The anterior lobe has a length of 202 mm. and a width of 309 mm. The epiplastral

lip is not well differentiated, being narrow, pointed, and not projecting beyond the rim of the carapace. The extremity is considerably thickened; but the borders are rather acute. The entoplastron has a width of 150 mm. Its hinder border can not be exactly traced, but the form of the bone has apparently been nearly circular.

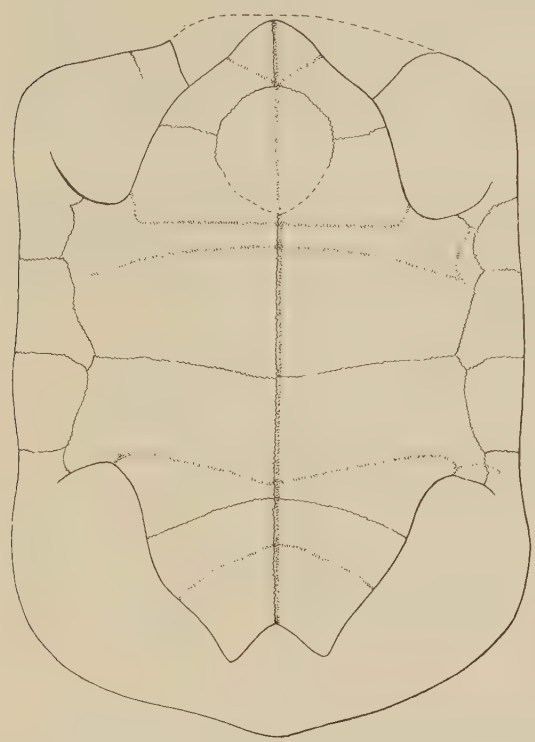


FIG. 481.—*Hadrianus schucherti.* Plastron. $\times\frac{1}{8}$. From type in U. S. N. M.

The bridge has a width of 281 mm., being therefore a little more than four-tenths of the length of the plastron.

The hinder lobe has a length of 202 mm. Its width is 309 mm. Its dimensions are therefore the same as those of the front lobe. The hinder extremity was notcht, but the angles on each side of the notch may not have been so acute and long as shown in the restoration and the figure.

The arrangement of the scutes is not, so far as can be determined, greatly different from that of other Testudinidæ. The gulars do not encroach on the entoplastron. The humero-pectoral sulcus runs straight across the plastron (not touching the entoplastron) until it approaches the axillary notches, when it turns abruptly forward. The pectoral scutes are very narrow, about 22 mm. at the midline, but they widen right and left. The abdominal scutes extend fore and aft a great distance, about 242 mm., this length being contained in the length of the plastron two and a half times. The femoral scutes have an extent of 56 mm. along the midline. There were evidently inguinal scutes; but no axillary scutes have been observed. The sulci between the plastral and the marginal scutes at the bridges appear to have lain on the plastral bones, near the sutures between the plastral and the peripheral bones.

The figure publisht in the Proceedings of the U. S. National Museum, vol. XXII, plate iv, is eight forty-fifths the size of the original, instead of one-seventh as stated on the plate. The diagrammatic figure forming plate v of that publication is 19 hundredths the natural size.

Genus ACHILEMYS nov.

An imperfectly known genus of the Testudinidæ. Carapace with recurved hinder peripherals. Sulcus between the fifth vertebral scute and the supracaudal crossing, as in *Stylemys*, on the last suprapygal. Plastron with a broad, extremely short lip, which is obtuse and which does not thicken backward on the upper surface as it does in other Testudinidæ.

Type: *Hadrianus allabiatus* Cope.

Achilemys allabiata (Cope).

Figs. 482–485.

Hadrianus allabiatus, COPE, Proc. Amer. Philos. Soc., XII, 1872, p. 471; 6th Ann. Report U. S. Geol. Surv. Terrs. (Hayden), 1872 (1873), p. 630; Vert. Tert. Form. West, 1884, p. 140, plate XV, figs. 13–15.—OSBORN, SCOTT, and SPEIR, Contrib. Mus. Geol., Archæol. Princeton College, No. 1, 1878, p. 94.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1903, p. 450; Amer. Geologist, XXXV, 1905, p. 333.

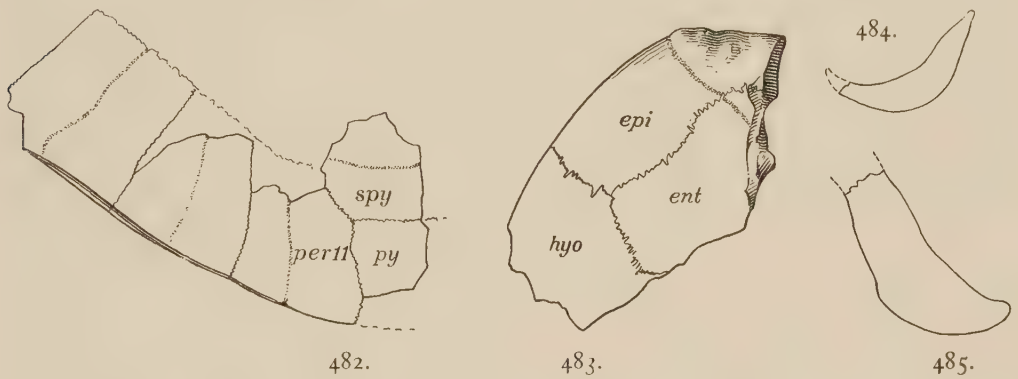
The type of the present species belongs to the U. S. National Museum and bears the number 4054. It consists of the right half of the front lobe of the plastron, 2 anterior peripherals, 3 hinder peripherals, a portion of the pygal, and a portion of the last suprapygal. It

was obtained by Professor Cope in the neighborhood of Cottonwood Creek, Wyoming, and comes from the Bridger Eocene beds, the level being that known as B.

Cope's description of this species is very brief and unsatisfactory, not even doing justice to the fragmentary materials at his command; yet including statements that imply that he had more materials than are now accessible. He states that the plastron was concave, yet we have no evidence that other parts of it were present than the half of the anterior lobe. The surface of the carapace is said to be without irregularities of surface, yet no neurals or costals seem to have been secured.

The size of the individual must have been greater than estimated by Cope. He says that the length was 18 inches, equal to 437 mm. Cope's fig. 14 of his plate represents the ninth, tenth, and eleventh peripherals of the right side, and about half of the pygal. The length of the ninth and tenth taken together amounts to 156 mm. The length of the same two elements of a specimen of *H. corsoni* whose carapace has a length of 590 mm. is 131 mm. An estimate based on these dimensions makes it probable that the type of the species had a length of about 626 mm., or about 25 inches.

It is improbable that this species belongs to the genus *Hadrianus*. Two reasons may be assigned for this opinion. The first is found in the fact that there is no epiplastral lip, a



FIGS. 482–485.—*Achilemys allabiatus*. $\times\frac{1}{3}$. Type.

482. Portion of rear of carapace. *per.* 11, eleventh peripheral; *py*, pygal; *spy*, suprapygal.
483. Portion of anterior lobe of plastron. *hyo*, hyoplastron; *ent*, entoplastron; *epi*, epiplastron.
484. Section of ninth peripheral.
485. Section at anterior end of eleventh peripheral.

structure found in the other species of the genus, except possibly in *H. tumidus*, the only known specimen of which does not present that region. In *Achilemys allabiata* this lip is not differentiated even so much as it is in the Emydidæ.

The second reason is found in the structure of the hinder region of the carapace. With the other bones of this species at Washington there is a portion of a suprapygal which joins accurately the eleventh peripheral and the pygal of the type. This is represented in its proper position in fig. 482. This bone has the position of the third suprapygal of *Testudo* and of *Hadrianus corsoni*. In the genera just named the sulcus between the last vertebral scute and the supracaudal scute follows closely the suture between the third suprapygal and the pygal. In the species being here described the sulcus crosses the suprapygal at some distance above the suture referred to. It is to be noted also that the three peripherals of this region are traverst by perpendicular sulci from top to free border, showing that the sulcus between the marginal scutes and the costal scutes ran on or above the sutures between the peripheral and costal bones. The position of the sulci of this region in our species resembles somewhat that of *Kachuga*, as represented by Mr. Boulenger (Cat. Chelonians, p. 53, fig. 16).

The epiplastron (fig. 483) figured by Cope has the anterior end thickened and rounded in section. More posteriorly this epiplastron has an acute border. At their symphysis the epiplastra have a thickness of 23 mm. The truncated end of the anterior lobe, the rudimentary lip, has a width of about 125 mm. The scute-covered area on the upper surface is 18 mm. wide. The bone on this surface does not thin backward as in *Testudo* and *Hadrianus*. The entoplastron had a width of about 170 mm. It was truncate or cordate behind, notwith-

standing Cope's statement. Its length was about 110 mm. The scutal sulci are very obscure on this fragment of the plastron, but the gulo-humeral is distinguishable.

An anterior peripheral has the upper surface nearly flat and the free border acute. The hinder peripherals (fig. 482) are strongly flared upward toward the free border, the ninth most so (fig. 484), the eleventh less so (fig. 485). The ninth has a width along the free border of 85 mm. and the height was about 90 mm. in a straight line. All the peripherals have a thickness of about 18 mm. The pygal is 21 mm. thick.

Cope states that the sulci are deeply imprest. Those of the carapace are distinct enough, but those of the front of the carapace are very narrow, shallow, and indistinct. The gulo-humeral sulcus is very narrow and shallow and distinguisht with difficulty.

Osborn, Scott, and Speir's identification of this species is based entirely on two ungual phalanges collected by them in the Bridger beds.

Genus STYLEMYS Leidy.

Testudinidæ with the plastron joined to the carapace by sutures, and with inguinal buttresses which pass a short distance within the carapace between the fifth and sixth costal plates. No hinge in either plastron or carapace. Of the neural plates, those behind the third are hexagonal and have the antero-lateral sides much the shortest. The second and third may be hexagonal; or the second may be octagonal and the third tetragonal. Two or three suprapygals; the penultimate, bifurcate. Ribs at distal ends of costal plates entering pits in peripherals of bridges. Costal plates with opposite ends differing much or little in width. Epiplastral lip not projecting beyond the general contour of the anterior lobe of plastron. Entoplastron in front of the humero-pectoral sulcus. Supracaudal scute single. Skull and limbs, so far as known, like those of *Gopherus*.

Type: *Stylemys nebrascensis* Leidy.

The relationship of this genus has been variously regarded. It was establisht by Leidy, the name being given through a misconception that the plastral buttresses were separate bones. On the discovery of his error Dr. Leidy employed for a while the name *Testudo* for the species of this genus, while in his latest work on the genus (Contrib. Ext. Fauna West. Terrs.) he vacillated between *Testudo* and *Stylemys*. This procedure indicates that he recognized the close relationships between the species with which he was dealing, *S. nebrascensis*, and the species of *Testudo*. Professor Cope recognized the validity of the genus. While regarding the Emydidæ and the Testudinidæ as forming distinct families, he referred *Stylemys* to the former, doubtless supposing that the digits possest three phalanges each.

It is the opinion of the present writer that the genus in question belongs to the Testudinidæ.

Unfortunately, we are even yet not thoroly acquainted with the osteology of the species of *Stylemys*. Probably thousands of shells of *S. nebrascensis* have been observed, yet we know of only one skull that has been found actually associated with its shell, no undisturbed foot likewise associated, and no cervical vertebræ whatever. In the collection at Princeton University there is the greater portion of a skull which is here figured as belonging to *S. nebrascensis* but it did not accompany a shell. In the Carnegie Museum at Pittsburg is a shell of *S. nebrascensis* accompanied by the skull. In the American Museum there are various bones of the internal skeleton about which there need be no doubt. All the indications furnisht by these remains point to a close relationship with our living land-tortoises. The skull has the structure of that of *Gopherus* (*Xerobates*). It seems quite certain that none of the digits possest more than two phalanges, but the proof is not complete. The scapula, the coracoid, the humerus, the forearm bones, the pelvis, and the bones of the hinder limbs agree with the corresponding bones of *Testudo* and *Gopherus*. A humerus of *S. nebrascensis* (fig. 492) shows that the radial and ulnar processes of the proximal end are twisted toward each other as in *Testudo*, and in a way entirely different from what we see in the Emydidæ. The form and structure of the shell agree rather with that of *Testudo* than with that of the Emydidæ. It is true that in the type species, *S. nebrascensis*, the neural bones and the costals have not undergone the modifications which characterize those of *Testudo;* but even here we meet with the beginnings of these modifications; and in the John Day species they become unmistakable. Here the second neural is octagonal, the third is tetragonal, and the costals have become wedge-shaped. A peculiarity of the hinder region of the carapace, seen rarely in the Emydidæ,

presents itself in *Stylemys*, viz., a bifurcate penultimate suprapygal. The nearest approach to this is seen in *Kachuga* (Boulenger, Cat. Chelonians, p. 53, fig. 16).

The epiplastral lip of *Stylemys* does not project forward beyond the general border of the plastron, as it does in most of the species of *Testudo;* yet the epiplastral bones are thickened anteriorly on the upper side in a manner similar to that found in *Testudo*.

The geological duration of the genus, so far as known, is from the lower Oreodon beds of the White River deposits to the John Day Miocene. The writer has not been able to find any records of the finding of specimens of the genus in the Titanotherium beds. It is remarkable that the genus *Hadrianus* should disappear in the Uinta deposits, while *Stylemys* and *Testudo* should appear immediately afterwards in the White River beds.

The writer has elsewhere (Amer. Geologist, XXXV, 1905, p. 342) exprest the opinion that the living North American species included under the name *Gopherus* (*Xerobates* Agassiz) have descended, not from *Hadrianus*, but rather from *Stylemys*. This opinion is based principally on the fact that the species of both groups have a longitudinal ridge along the midline of the triturating surface of the upper jaw. This idea requires the confirmation to be obtained only in the discovery of more complete skeletons.

Analysis of Species of Stylemys.

1. Shell nearly as broad as long. Seldom an octagonal neural present. Pectoral scute, on midline, three-tenths width of abdominals; free borders of hinder peripherals acute.. *nebrascensis*
2. Shell nearly as broad as long. Second neural octagonal, third quadrangular; pectoral scutes one-fifth width of abdominals; hinder peripherals obtuse ..... *capax*
3. Shell more elongate; neurals as in *capax;* peripherals more as in *nebrascensis* ..... *conspecta*
4. Not well known. Third neural 4-sided; anterior lobe truncated in front ..... *calaverensis*

Stylemys nebrascensis Leidy.

Plate 59, figs. 2–4; plate 62, figs. 1, 2; text-figs. 486–496.

Stylemys nebrascensis, Leidy, Proc. Acad. Nat. Sci. Phila., v, 1851, p. 172; Ann. Rept. U. S. Geol. Surv. Wyoming, etc., 1870 (1871), p. 366; Contrib. Ext. Fauna West. Terrs., 1873, p. 224.—Cope, Trans. Amer. Philos. Soc., XIV, p. 124, plate vii, figs. 10–12; Vert. Tert. Form. West, 1884, p. 769; Contrib. Canad. Palæont., III, 1891, p. 5.—Lydekker, Proc. Zool. Soc. Lond., 1889, p. 94.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 450; Ann. Carnegie Mus., IV, 1906 (1907), p. 19, figs. 9–11.

Emys hemispherica, Leidy, Proc. Acad. Nat. Sci. Phila., v, 1851, p. 173; 6th Ann. Rept. Smithson. Inst., 1851 (1852), p. 65.

Testudo lata, Leidy, Proc. Acad. Nat. Sci. Phila., v, 1851, p. 173; 6th Ann. Rept. Smithson. Inst. 1851 (1852), p. 65; Owen's Rept. on Geol. Surv. Wis., Iowa, and Minn., 1852, p. 572; Ancient Fauna Nebraska, in Smithson. Contrib. Knowl., VI, 1854, art. vii, pp. 110, 115, plate xxiii, figs. 1, 2, plate xxiv, fig. 1.—Maack, Palæontogr., XVIII, 1869, p. 246.

Emys oweni, Leidy, Proc. Acad. Nat. Sci. Phila., v, 1851, p. 327.

Emys culbertsonii, Leidy, Proc. Acad. Nat. Sci. Phila., VI, 1852, p. 34.

Testudo hemispherica, Leidy, Proc. Acad. Nat. Sci. Phila. 1852, VI, p. 59; Owens' Rept. on Geol. Surv. Wis., Iowa, and Minn., 1852, p. 570, plate xiiB, figs. 1, 2; Ancient Fauna Neb. 1854, pp. 105, 115, plate xx, figs. 1, 2, plate xxiv, fig. 3.—Winckler, Arch. Mus. Teyler, II, 1869, p. 146, plates XXXI–XXXIII.—Maack, Palæontogr., XVIII, 1869, p. 245.

Testudo nebrascensis, Leidy, Proc. Acad. Nat. Sci. Phila., VI, 1852, p. 59; Owen's Rept. on Geol. Surv. Wis., Iowa, and Minn., 1852, p. 567, plate xiiA, figs. 1, 2; Ancient Fauna Neb., pp. 103, 115, plate xix, figs. 1–3; Jour. Acad. Nat. Sci. Phila., (2), VII, 1869, p. 26 (*Testudo*, or *Stylemys neb.*); Contrib. Ext. Fauna West. Terrs., 1873, p. 339, plate xix, figs. 7, 9, 10—Maack, Palæontogr., XVIII, 1869, p. 245.—Marsh, Amer. Jour. Sci., (2), L, 1870, p. 292.—Zittel, K. A., Handbuch Palæont., III, 1889, p. 540, fig. 501.

Testudo oweni, Leidy, Proc. Acad. Nat. Sci. Phila., VI, 1852, p. 59; Owen's Rept. on Geol. Surv. Wis., Iowa, and Minn., 1852, p. 568, plate xiiA, figs. 3, 4; Ancient Fauna Neb., 1854, pp. 106, 115, plate xxi, figs. 1, 2, plate xxiv, fig. 4.—Maack, Palæontogr., XVIII, 1869, p. 245.

Testudo culbertsonii, Leidy, Proc. Acad. Nat. Sci. Phila., VI, 1852, p. 59; Owen's Rept. on Geol. Surv. Wis., Iowa, and Minn., 1852, pp. 569, plate xii, figs. 1, 2; Ancient Fauna Neb., 1854, pp. 108, 115, plate xxii, figs., 1, 2, plate xxiv, fig. 2.—Maack, Palæontogr., XVIII, 1869, p. 246.—Haberlandt, Jahrb. k. k. Reichsanst., XXVI, 1876, p. 243.

Emys nebrascensis, Leidy, 6th Ann. Rept. Smithson. Inst., 1851 (1852), p. 65.

Emys lata, Leidy, 6th Ann. Rept. Smithson. Inst., 1851 (1852), p. 65

Stylemys culbertsonii, Cope, Trans. Amer. Philos. Soc., XIV, 1869, p. 124.

This species is by far the most abundant fossil turtle found in any of the geological formations in North America. Many years ago Dr. Leidy stated that he had seen hundreds of the shells; and since that time many in addition have been collected and deposited in the various museums. Some individuals attained a large size. Most of the specimens seen in museums are of small or moderate size, for the large shells have not usually been regarded by collectors as worth the trouble and expense of transporting. Statements made by reliable collectors are to the effect that individuals are sometimes met with which have had a length of 3 feet (890 mm.) The type of Leidy's *Testudo lata* had a plastron 21 inches (about 530 mm.) long. The largest shell in the American Museum of Natural History is 510 mm. long, 375 mm. wide, and 265 mm. high.

The species was described in early days by Leidy under several specific names, which are mentioned in the synonymy. These so-called species were based in some cases on purely individual characters; in others, on modifications of form due to distortion. Dr. Leidy himself was the first to correct these errors. The specimens from which were drawn the following figures publisht by Leidy in vol. VI of the Smithsonian Contributions to Knowledge are in the U. S. National Museum: Plate xix, figs. 1, 2, 3 (*Testudo nebrascensis*); plate xx, figs. 1, 2 (*T. hemispherica*); plate xxi, figs. 1, 2 (*T. oweni*). The specimens from which were obtained the figures of *T. lata*, op. cit., plate xxiii, plate xxiv, fig. 1, are in the Philadelphia Academy.

In form this tortoise was broad and rather high and vaulted. The height and convexity appear to have increast with age. Often the rather low and flattened form is due to pressure exerted during fossilization. Nevertheless, among specimens of the same size there are differences in the form and height of the shell which must have existed during the life of the animals.

The width of the shell forms about 85 per cent. of the total length. In outline the carapace is truncated in front, or even a little concave; behind, it is broadly rounded. The peripherals over the bridges are nearly or quite perpendicular; those over the limbs are slightly flared; those in front slope downward and forward, or flare slightly upward; the pygal is nearly perpendicular. The free edges of the anterior and posterior peripherals, the nuchal, and the pygal are acute. The neurals, excepting the first, which is oval, are almost always hexagonal, with the two shortest sides directed forward. Occasionally, as in the type of Leidy's *T. culbertsoni*, the second neural is octagonal, the third quadrangular (Ancient Fauna Neb., plate xxii, fig. 1). There are usually 2 suprapygals, the larger anterior of which is bifurcated, as in *Testudo;* the smaller posterior one is rhombic, with its lower border fitting in a notch in the upper border of the pygal. In Leidy's type just referred to there is an accessory plate in front of the first suprapygal; and the same condition is occasionally met with in other specimens.

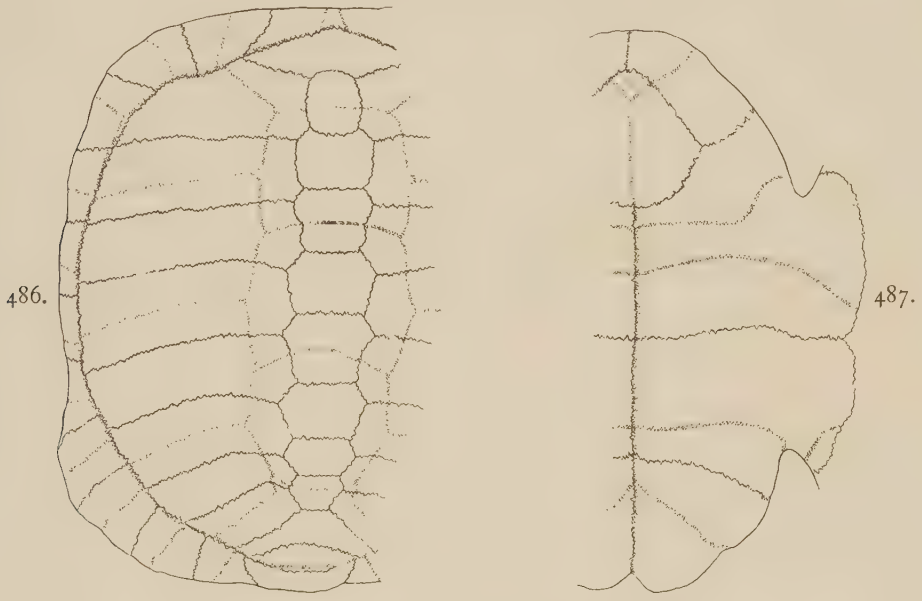
The costal plates are modified somewhat as they are in the genus *Testudo*. The second, fourth, and sixth are somewhat widened distally and narrowed proximally, while the third and fifth are narrowed at the distal end and widened at the proximal. The degree of this differentiation varies somewhat with individuals, and in general is not so much developt as in *S. conspecta* and *S. capax*. In uncrusht examples of the species the bridge peripherals rise nearly half the height of the shell. In a specimen whose length of carapace is 260 mm. the height of these peripherals is 58 mm. The suture between the costals and the peripherals is a very loose one, as in *Testudo*.

The sulci bounding the carapacial scutes are narrow, but rather deeply imprest. The nuchal scute is very narrow. The first vertebral is wider by one-half than the second. The fourth is somewhat narrower than the second and the third; while the fifth is nearly as wide as the first. On the bridge peripherals the sulci run obliquely downward and forward. The sulci between the costal scutes and the marginals follow closely the sutures between the costal and peripheral bones. On the hinder pygal the sulcus runs slightly above the suture.

The anterior lip of the plastron projects little, if any, beyond the general curve of the anterior lobe. The outline of the lip is rounded or repand, and the edge is rather acute. Superiorly the lip thickens backward for a distance about equal to the width of a gular scute, and then ceases abruptly, but there is no excavation behind it. The entoplastron is narrow in front and broad behind. The width of the bridges is not quite one-half the length of the plastron. The lobes are so wide that space is left only for the movement of the limbs and for the tail. There is a notch in the hinder border of the plastron, and the apices of the xiphi-

plastra on each side of this are rounded. The bone of the plastron is relatively thick. In the case of a specimen whose plastron is 210 mm. long the thickness of the hyoplastron is 16 mm.; that of the hypoplastron half-way between the median line and the inguinal notch is 14 mm. Proceeding backward from the inguinal notch near the free border there is a low wall from the summit of which the bone slopes downward and outward. Farther backward the height of the wall diminishes rapidly and the slope is less steep, so that on the apices of the xiphiplastra the sloping face looks nearly upward. From the summit of the wall the surface slopes very slowly toward the midline.

The gular scutes overlap slightly the entoplastron. The humero-pectoral sulcus crosses the midline just behind the entoplastron. The pectoral scutes are rather narrow at the mid-



FIGS. 486 AND 487.—*Stylemys nebrascensis*. $\times \frac{1}{3}$.

486. Carapace. 487. Plastron.

line. The abdominals are the widest of the plastral scutes. At the midline the femorals are about as wide as the pectorals. The anals occupy somewhat more of the midline than do the femorals. Small axillary and inguinal scutes are present.

Figs. 1 and 2 of plate 62 furnish illustrations of the shell of a specimen of the species, No. 1433 of the American Museum of Natural History. The figures are half the natural size. Text-figs. 486 and 487 are derived from the same specimen.

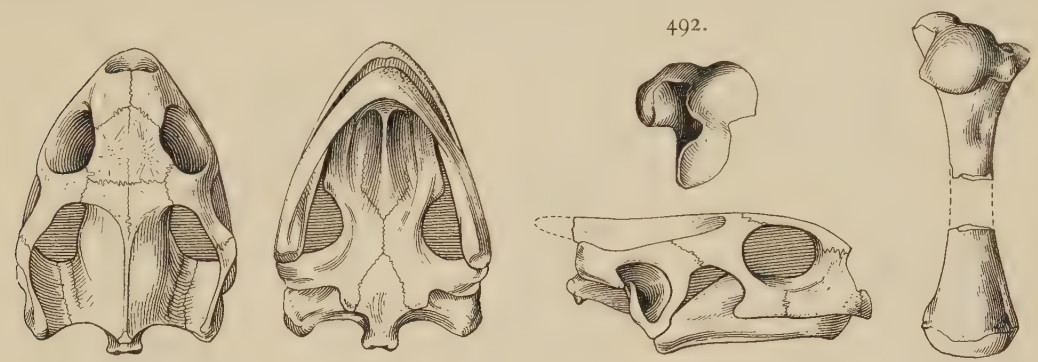
It is remarkable that, notwithstanding the great number of individuals of this species which have been found, few skulls have hitherto been discovered. Leidy, writing many years ago, stated that he had seen hundreds of shells but no skull. The one here described as probably belonging to this species belongs to Princeton University.

This specimen (plate 59, figs. 2, 3) was collected by Mr. J. W. Gidley, now of the U. S. National Museum, in the year 1896. It was found in the Oreodon beds of the Hat Creek Basin, near Prairie Dog Creek, Nebraska. It was not accompanied by any other parts; but in the White River deposits of that region *Stylemys nebrascensis* is abundant; and no other related species, except one specimen of *Testudo brontops*, of the Titanotherium beds and *T. thomsoni* of the lower Oreodon beds has been found in the White River Oligocene; so that the probability is very great that the skull belongs to this species. This probability is confirmed by the skull next to be described.

Unfortunately, the Princeton skull is not complete. The hinder segment is missing, as well as the quadrates. There is likewise no lower jaw present, and there are some minor deficiencies.

In general the structure of the skull resembles that of the genus *Gopherus*, and therefore in general that of *Testudo*. As regards its size, in case the ratio of the portion behind the orbits to that from the postfrontal bones to the tip of the snout was the same as in the skull of either *Gopherus polyphemus* or of *Testudo tabulata*, the whole length from snout to occipital condyle must have been about 75 mm., and the breadth at the quadrates about 61 mm. The orbits are large, about 20 mm., hardly smaller proportionately than they are in the *Testudo* mentioned. The interorbital space is 15 mm. wide. The upper surface of the skull, from the nostrils to near the hinder border of the frontals, is gently convex. The parietals are more convex both longitudinally and transversely.

The sides of the face just behind the nostrils were nearly perpendicular. The nasal opening is nearly quadrate, and was 16 mm. wide and about 10 mm. high. The cutting-edges of the maxillaries make about the same angle with each other that they do in *T. tabulata* and *G. polyphemus*. There is a broad notch in the cutting-edge at the premaxillary symphysis; and behind this on each side there is an indication of a tooth. The masticatory surfaces of the upper jaws resemble in breadth those of the genus *Gopherus*. Along the middle of each



FIGS. 488–492.—*Stylemys nebrascensis*. Skull and humerus.

488. Upper view of skull. ×1. No. 1571 Carnegie Museum.
489. Lower view of same. ×1.
490. Side view of same. ×1.
491. Right humerus, dorsal view. ×⅔. No. 700 A.M.N.H.
492. Right humerus, proximal end. ×⅔.

surface there is a tootht ridge which runs parallel with the cutting-edge. In front, a longitudinal ridge runs backward from the symphysis, as in *G. polyphemus*, a character which has led to the separation of the North American species of *Testudo*, to form the genus *Gopherus*. In *Stylemys* a less elevated ridge is developt on the inner border of the maxillary. The structure of the upper jaw is like that of *Gopherus polyphemus*, except that in *Stylemys* the masticatory ridges do not join the longitudinal ridge.

As in *Testudo* and *Gopherus*, the palate is archt upward high above the level of the masticatory surfaces; and there is a sharp ridge which, starting on the vomer, is continued backward to the hinder end of the latter bone and on the conjoined edges of the pterygoids. The width of the vomer, where it articulates with the premaxillaries and the maxillaries, is considerable, as it is also in *G. polyphemus*. In *T. tabulata* the vomer is narrow anteriorly and articulates only slightly with the maxillaries.

The vaulted roof of the mouth continues backward as far as the bones of the skull are preserved, and judging from *Testudo*, to a line joining the front borders of the articular ends of the quadrates. In the specimen the vaulted roof has been forced upward and broken across the middle, and a portion of it is missing; but the hinder end of the vomer is present, and extended backward about 25 mm. from the anterior end. The palatines extend backward as far as the hinder end of the vomer. The nasopalatine and posterior palatine foramina have the same positions as in *Gopherus*. The former is rather small.

The postfrontal and jugal bones are missing; as are also the prootics, squamosals, and quadrates.

No. 1571 of the Carnegie Museum, Pittsburg, furnishes a nearly complete skull of a small individual (text-figs. 488, 489, 490). This skull is accompanied by enough of the shell to establish clearly the species. The remains were collected in 1905, by Mr. Earl Douglass, of the Carnegie Museum, in the Oreodon beds of the Little Badlands, southwest of Dickinson, Stark County, North Dakota. So far as the parts presented by this skull and that belonging to Princeton University are common, they agree closely. The length of the skull, from the snout to the occipital condyle, is 38 mm.; the width at the quadrates, 30 mm. The hinder border of the postorbital bar is equally distant from the occipital condyle and the snout. The bar just mentioned is 5 mm. wide; the zygomatic bar is slightly wider. The interorbital space is 10.5 mm. wide. The antero-posterior diameter of the orbit is 11 mm.; the vertical, 9 mm. The longest diameter of the auditory chamber is 9 mm. The pterygoid region is 10 mm. wide. The pedicel of the quadrate is unusually narrow, only 4 mm. from side to side.

The palate is deeply excavated, and a low sharp ridge runs along the middle of it. Most of the lower jaw is firmly held in its natural position; but the removal of the tip exposes a low median ridge along the palatal part of the symphysis of the premaxillæ. It is evident therefore that the larger skull described above is correctly identified.

Few satisfactory specimens of the bones constituting the shoulder-girdle of adult individuals have been secured. In the American Museum these bones belonging to a young animal (No. 699, from South Dakota) are present. The scapula is slender and makes an angle of about 120 degrees with the procoracoid process. The coracoid broadens greatly toward the free end.

No figure of the humerus has hitherto been publisht. Professor Cope (Ext. Bat., Rept, Aves N. A., 1869, plate vii, figs. 12, 12*a*) presents a figure which is explained as being that of the humerus of this species; but the figure is that of the femur. The humerus of the specimen mentioned above, No. 699 of the American Museum, shows that the bone had nearly the form that it has in *G. polyphemus*, but it is bent slightly more than in the species just named. Other larger but imperfect specimens confirm this conclusion. Fig. 491 is taken from one of these, No. 700, American Museum, but a portion of the shaft is missing. This specimen was found with the shell. Figure 492 is a view taken from the proximal end, to show the head and the radial and ulnar processes. The ulnar process does not rise so much above the head as in *Testudo radiata*. The angle between the processes is reduced as in *Testudo* and is thus different from the condition found in the Emydidæ. The ectepicondylar foramen is close to the distal end of the bone.

The Amerian Museum of Natural History possesses the left forearm and some foot bones of a large specimen believed to be of this species, No. 702, collected by the museum's expedition of 1892, in South Dakota. A drawing (fig. 493) is presented of the ulna, radius, intermedium, radiale, the ulnare, the fourth distal carpal, and another (fig. 494) of a digit, including one claw phalange. The limb is stouter than it is in any of the species of *Testudo* at hand, but resembles them closely. The proximal end of the ulna is broad, and forms a prominent olecranon process. The distal ends of both radius and ulna are flat for articulation with the carpals. The radius forms a prominent styloid process. The terminal phalanges are much larger relatively than they are in most species of *Testudo*, but approach nearest those of *Gopherus polyphemus*. They differ from the latter in not being so broad and sharp-edged. From the materials at hand it can not be determined whether there were two or three phalanges in the median toes; but no elongate phalanges are present.

There are at hand the ilium and a portion of the pubis of a specimen, No. 1301, from Old Woman's Creek, Wyoming (fig. 495). On comparison with the corresponding bones of *Testudo vaga*, no differences of importance are observed, except that the flat process extending backward from the upper end of the ilium is directed slightly inward, instead of outward. Cope furnisht a figure of a small portion of the pelvis (Ext. Batrach, Rept., Aves N. A., plate vii, fig. 11).

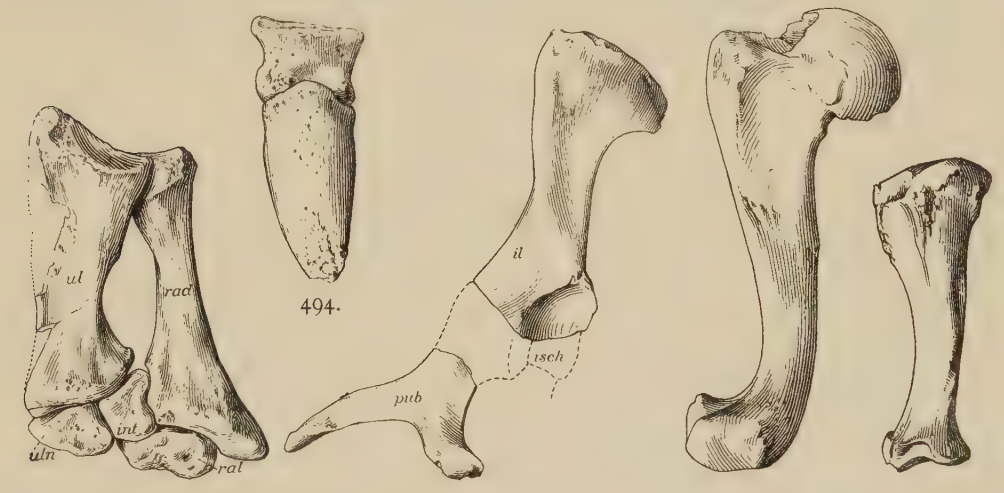
The femur is like that of *Testudo vaga*, except that the pit between the trochanters is not so deep. Cope's figure of this bone has been referred to in the description of the humerus. No. 1301, A. M. N. H., furnishes this bone from the left side (fig. 496). It is shown two-thirds the size of nature in fig. 496. It resembles closely the corresponding bone of *Gopherus polyphemus* but the lower articular surface is more deeply grooved and there is a distinct and sharp ridge separating the tibial from the fibular surface.

The tibia is a stout bone, whose form may be learned from figure 497, which represents the left tibia of No. 1301, just mentioned. It is a much stouter bone than is the corresponding bone in *Gopherus polyphemus*. Its length is seven-tenths that of the femur, whereas in *G. polyphemus* the tibia is eight-tenths the length of the femur.

The lower end of the fibula is quite as broad as that of the tibia. Professor Cope figured one of the metatarsals (Ext. Batrach., Rept., Aves N. A., plate vii, fig. 10).

In a collection of fossils, including some vertebrates purchased by the American Museum of Natural History from the late James Hall, there are several eggs which are regarded as those of *S. nebrascensis*. This identification rests on the facts that these eggs were collected in the White River deposits of Dakota, in which great numbers of this species occur and a few other species of tortoise and that they agree closely in size and form with those of *Gopherus polyphemus*, as represented by Agassiz's figure (Contrib. Nat. Hist. U. S., ii, plate vii, figs. 28, 29). These eggs appear to have been globular, altho now shorter along one axis, a condition doubtless due to pressure. The diameter along all the axes, except the shorter, is 47 mm.; along the shorter, 43 mm. Fig. 4, plate 59, represents one of these eggs four-fifths the natural size.

The eggs of *G. polyphemus* figured by Agassiz have diameters varying from 40 mm. to 45 mm., the axes of the same egg being, in some cases, unequal.



493. 495. 496. 497.

FIGS. 493–497.—*Stylemys nebrascensis*.

493. Left ulna, radius, and three carpal bones; palmar surface. ×½. No. 702 A. M. N. H. *int*, intermedian; *rad*, radius; *ul*, ulna; *uln*, ulnare.
494. Digit, dorsal surface. ×1. No. 702 A. M. N. H.
495. Pelvis, left side. ×½. No. 1301 A. M. N. H. *il*, ilium; *pub*, pubis.
496. Left femur, tibial border. ×⅔. No. 1301 A. M. N. H.
497. Left tibia, dorsal surface. ×⅔. No. 1301 A. M. N. H.

No. 1435 A. M. N. H. is a specimen of a very young turtle of this species which was collected by one of the American Museum's expeditions to South Dakota. The shell is nearly complete, but is somewhat deprest by the weight of the overlying rocks. The total length was near 75 mm., the breadth, 70 mm. Altho the bones are loosely connected, there are no fontanels. The plastral lip is relatively broad, and in the middle of each lateral half there is a notch. The free borders of the carapace have been slightly notcht and mucronated; at least, some mucros are seen on the hinder peripherals.

So far as is known to the writer, no specimens of this species have yet been found in the lowermost division of the Oligocene, the Titanotherium beds. They are most abundant in the Oreodon beds, but occur in the Protoceras beds also. The species is extremely abundant in South Dakota and is found also in Nebraska, Colorado, and Wyoming. In the Cope collection in the American Museum are specimens that were collected on Old Woman's Creek, Wyoming, by J. C. Isaac, in 1877. Other specimens were obtained in the Oreodon beds of Logan County, Colorado, by one of the expeditions from the American Museum of Natural History in 1898.

Stylemys oregonensis Leidy.

Stylemys oregonensis, LEIDY, Proc. Acad. Nat. Sci. Phila. 1871, p. 248.—COPE, Bull. U. S. Geol. Surv. Terrs., v, 1879, p. 55.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.
Testudo oregonensis, LEIDY, Contrib. Ext. Vert. Fauna West. Terrs., 18, pp. 226, 340, plate xv, fig. 10.

In the year 1871, as cited above, Dr. Leidy proposed the name *Stylemys oregonensis* for a species of turtle whose former existence he inferred from a single neural plate, supposed then to be the eighth, sent to him from the John Day deposits of Oregon, the more exact locality being given as Crooked River. In the later publication cited (1873) the specimen is figured and briefly described, being here regarded as the third neural. On page 340 of this work the suspicion is exprest that the species is identical with that from the White River deposits, *Stylemys nebrascensis*. Professor E. D. Cope possest in his collection a number of well-preserved specimens of a turtle from the John Day River region; and these he regarded as identical with that described by Dr. Leidy and with *S. nebrascensis*. He notes various differences, but he did not find them to be constant.

Whatever Leidy's type neural may be it is not the third neural of any known Oregon species of *Stylemys*, his type being hexagonal, that of the John Day species of *Stylemys* being quadrangular. It is more probably the fifth neural, but not with any certainty that of *Stylemys*. If a *Stylemys*, it may belong to either or neither of the two species recognized below by the present writer.

Stylemys capax sp. nov.

Plates 60, 61; text-figs. 498, 499.

Stylemys nebrascensis, in part, COPE, Vert. Tert. Form. West, 1884, p. 770, "No. 2."

The specimen which furnishes the description of this supposed new species was collected for Professor Cope from the John Day beds of Oregon. The exact locality is said to have been the "Cove," in the region of the junction of the North Fork and South Fork of the John Day River, in the western part of Grant County. The level is doubtless the Middle John Day or the Diceratherium beds. This author regarded this individual, as well as the other John Day specimens, as identical with *S. nebrascensis*, from the White River deposits. A brief description and some measurements of this individual were furnisht by Cope as cited above.

The specimen now bears the American Museum's catalog number, 1357.

In form this species is of moderate width and height, and both the anterior and the posterior borders are broadly rounded. The upper surface is convex in all directions. The peripherals over the limbs are little, if any, flared. The anterior lobe of the plastron is long and projects somewhat beyond the carapace. The hinder lobe is deeply notcht.

Costal.	Width upper end.	Width lower end.
1	60	..
2	33	68
3	55	30
4	36	70
5	44	38
6	35	53
7	20	42
8	20	54

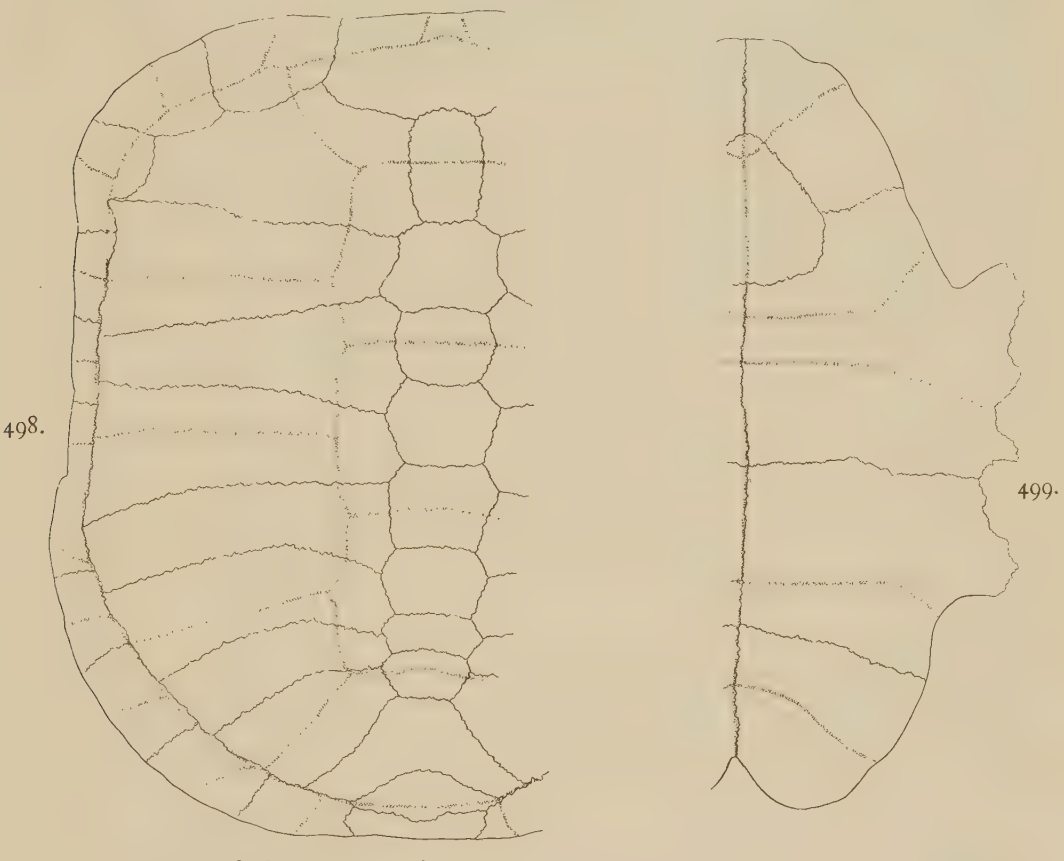
The length of the carapace (plate 60; text-fig. 498), taken in a straight line, is 455 mm.; its greatest width is 360 mm. The nuchal resembles that of *S. conspecta*. The neurals differ from those of the species just named in being somewhat broader in proportion to their length. There are not so great differences among the costals as regards their widths as in *S. conspecta*; but this condition may be due to individual variation. The table herewith gives the widths of each of the costals at its upper and lower ends, excepting the first and the eighth.

The peripherals are remarkable for their thickness and the obtuseness of their free borders, being in these respects quite unlike those of *S. conspecta*. The second peripheral is 35 mm. thick, measured on the sulcus between the first and second dermal scutes. The border is obtuse, with only a suggestion of an edge. In the type of *S. conspecta*, with shell nearly as long (415 mm.), the second peripheral is only 25 mm. thick, and it comes down to an acute edge. The hinder peripherals have a very obtuse border, nearly resembling the border of the fleshy part of one's hand. The thickness of most of these hinder peripherals is 35 mm. The corresponding ones of *S. conspecta* are 25 mm. thick and are sharp-edged.

The total length of the plastron (plate 61; text-fig. 499) reaches 415 mm. The anterior lobe is 147 mm. long and 215 mm. wide at the base. The lip extends beyond the border of the

carapace about 25 mm. Its anterior extremity is broad and rounded. The distance between the points where the gular sulci cross the free border is 117 mm. The greatest thickness of the lobe, at the base of the lip, is 30 mm. There is a slight excavation at the base of the lip on the upper surface. The edges of the anterior lobe are subacute.

The posterior lobe has a length of 120 mm. and a width of 215 mm. at the base. The thickness of the border of the hypoplastron just behind the inguinal notch is 37 mm.; whereas in *S. conspecta* it is only 23 mm. The notch in the rear of this lobe has a depth of 25 mm.



FIGS. 498 AND 499.—*Stylemys capax*. Carapace and plastron of type. ×¼. No. 1357 A. M. N. H.

498. Carapace. 499. Plastron.

The form and proportions of the scutes, upper and lower, do not differ in any important way from those of *S. conspecta*. The humero-pectoral sulcus falls at a considerable distance behind the border of the entoplastron, but this may be only an individual peculiarity.

This species is remarkable for the thickness of the peripheral and plastral bones and for the obtuseness of the free borders of the anterior and posterior peripherals. The width also is proportionately greater than that of *S. conspecta*, being only a little less than 80 per cent. of the length of the carapace.

Stylemys conspecta sp. nov.

Plate 64, figs. 1, 2; text-figs. 500, 501.

Stylemys nebrascensis, in part, COPE, Vert. Tert. Form. West., 1884, p. 769.

The type of this species is a large and fine shell which belongs to the Cope collection and is now in the American Museum, bearing the number 1358. It was collected in 1878, by Mr. Charles H. Sternberg, and appears to have been found near the junction of North Fork and South Fork of the John Day River, in Grant County, Oregon. Its level is supposed to be the middle beds of the John Day formation, the Diceratherium beds of Marsh.

Cope regarded these turtles as belonging to *Stylemys nebrascensis*, the common species of the White River beds of South Dakota. A study of these shells and a careful comparison of them with the South Dakota form has convinced the writer that they are specifically different and, moreover, belong to two distinct species, one of which is the present, the other *S. capax*.

The only injury that the type specimen suffered during fossilization is a slight lateral compression and a moderate thrusting of the plastron upward toward the carapace. The total length of the carapace (plate 64, fig. 1; text-fig. 500) in a straight line is 415 mm.; the width of the shell is 215 mm.; the present height is 170 mm. The original width may have been as much as 300 mm.; the height as much as 180 mm. These estimates would make the width of the shell about 72 per cent. of the length. The carapace is high and convex both longitudinally and transversely. Over the bridges the sides were perpendicular or nearly so. There was little or no flare to the anterior and posterior peripherals. In outline, both the front and hinder ends are broadly rounded. Where the sulci crost the free border the latter is mucronated. The nuchal bone is 65 mm. wide along the free border, posteriorly expanding to 95 mm. The first neural is elongated and oval. The second is octagonal; the third is nearly square; the others, hexagonal and mostly with the shorter sides in front. The anterior pygal is bifurcated. The one behind it is four-sided, its hinder border fitting in a notch in the pygal. The latter bone is somewhat incurved, and is 51 mm. wide and 50 mm. long on the midline.

Costal.	Upper end.	Lower end.
2	30	68
3	48	20
4	35	70
5	38	22
6	30	68
7	21	30

The costal plates are alternately wide and narrow, having nearly as high a degree of differentiation as those of the genus *Testudo*. The accompanying table presents the widths of the upper and the lower ends.

The first and second peripherals have a width of 60 mm. along the free border; their extent backward from this border is 57 mm. The eighth is 70 mm. high and 47 mm. wide. All the free peripherals, as well as the nuchal and the pygal, come down to an acute free edge. An obscure carina crosses the bridge peripherals from the free border of the anterior to the free border of the posterior peripheral.

The nuchal scute is 27 mm. long and 16 mm. wide. The first vertebral is 126 mm. wide in front. The second and third are about 83 mm. wide; the fourth, 72 mm.; the fifth, 110 mm. wide posteriorly. On the anterior peripherals the sulci between the marginal scutes and the costals fall considerably below the sutures between the peripheral and costal bones. On the sides and posteriorly the sulci are little below the sutures; on the posterior suprapygal, above the suture.

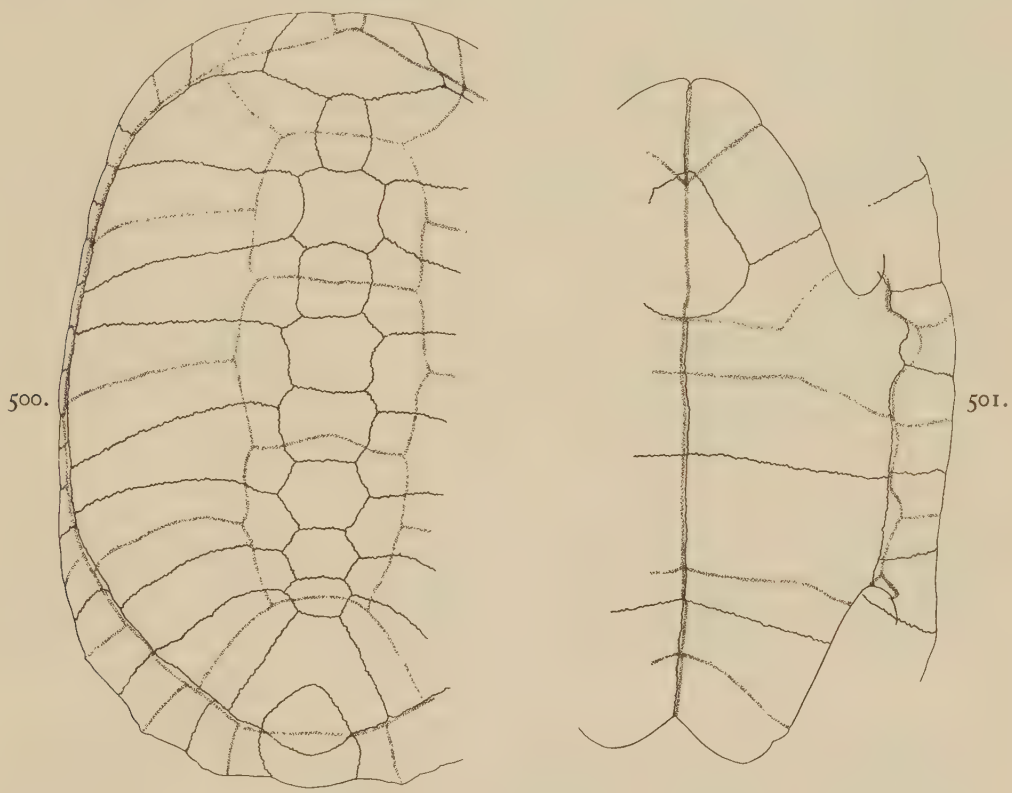
The plastron (plate 64, fig. 2; text-fig. 501) has a total length of 360 mm. Its general form is as in *S. nebrascensis*. The anterior lobe has a length of 120 mm. and a width of 166 mm. at the base. It did not project beyond the front of the carapace. The front of the lip falls within the general curve of the lobe. The lower surface of the lip is flat, while the upper surface curves down to meet it. In *S. nebrascensis* the upper and the lower surfaces are about equally convex. The entoplastron has the form that it has in *S. nebrascensis*. The bridge has a width of 150 mm.

The posterior lobe is 105 mm. long and 180 mm. wide at the base. The notch in the posterior border is somewhat larger than is usual in *S. nebrascensis*. As to the thickness of the bone, the sloping lateral face behind the inguinal notch, the free border more posteriorly, and the form and proportions of the various scutes, the lobe presents nothing to distinguish it especially from the White River species.

Another specimen belonging to the Cope collection, No. 1359, presents some differences from the shell just described. The length is 255 mm., the width, 177 mm. The front border is slightly concave in outline. The neurals are nearly as wide as those of the larger specimen just described. The first suprapygal is pentagonal, not bifurcated. The second is 23 mm. high and 56 mm. wide, and appears to include within itself the limbs of the usually bifurcate first suprapygal. There is a rather sharp carina along the sides above the bridge. The anterior vertebral scute is hardly as wide as are the second and the third; while the fifth is but little wider than those just mentioned.

No. 1354 of the Cope collection has a length of 219 mm. and a width of 160 mm. Its anterior border is concave, the neurals are of moderate width, the pygal is bifurcate, the peripherals over the hind limbs somewhat flaring, and there is a conspicuous and sharp carina along each side. The vertebral scutes are like those of No. 1359. There is a considerable depression on the area of the second, third, and fourth vertebral scutes. No. 1355 is an injured shell, but shows an anterior slightly concave outline. A peculiarity is presented in the anterior neurals. The first is broad in front and comes into contact with the second costal plates. The second is hexagonal, with the shorter sides behind. The third seems to have had four convex sides. The anterior vertebral scute has been 64 mm. wide; the second, 52 mm. wide.

No. 1351 is a small turtle, 145 mm. long, which has the first and fifth vertebral scutes about as wide as the second and third.



FIGS. 500 AND 501.—*Stylemys conspecta.* Carapace and plastron of type. $\times\frac{1}{4}$. No. 1358 A. M. N. H.

500. Carapace. 501. Plastron.

Notwithstanding the differences observed among the specimens just described, the writer feels compelled to refer them all to a single species.

Stylemys conspecta appears to differ from *S. nebrascensis* in the following respects: The shell is narrower in proportion to its length. The width forms about 75 per cent. of the length, whereas in *S. nebrascensis*, the width is usually, if not always, about 85 per cent. of the length. In *S. nebrascensis* the second and third neurals are almost always hexagonal. Only in the specimen described by Leidy as *S. culbertsonii* has the writer observed an octagonal second neural. In only one specimen of *S. conspecta*, No. 1354, above described, has the second been observed to be not octagonal, and this specimen has other irregularities. The costal plates of *S. conspecta* are more highly differentiated than those of *S. nebrascensis*, as has been described. The anterior peripherals of *S. conspecta* do not extend so far backward from the free border as those of *S. nebrascensis*. The position of the sulci between the anterior marginal and the

costal scutes of *S. conspecta* lies well in front of the hinder border of the peripheral bones. The carinæ along the sides of the Oregon species are usually more distinct than in the White River form, in which they seem never to be well developt.

Stylemys conspecta belongs to a later epoch than does *S. nebrascensis* and has evidently advanct to a stage nearer to *Testudo* than the earlier species.

From *S. capax* the present species differs in being of a more elongated form and in having the free borders of the peripherals very acute instead of obtuse.

Stylemys calaverensis Sinclair.

Text-figs. 502, 503.

Stylemys calaverensis, SINCLAIR, Univ. of Cal. Pubs.; Bull. Dep't. of Geol., III, 1903, p. 243, figs. 1, 2.

This species is represented by little else than the type, which belongs to the University of California. It was found in the auriferous gravels about 2 miles below Vallecito, Calaveras County, California. These gravels have been supposed to belong in the Miocene. It has not been seen by the writer, and the following description is based wholly on Sinclair's description and illustrations.

The specimen consists of the crusht anterior two-thirds of the carapace and plastron. The carapace (text-fig. 502) includes the greater portion of the first 6 costals of the left side, the proximal ends of the second, third, fourth, and fifth costals of the right side, the second

502. 503.

FIGS. 502 AND 503.—*Stylemys calaverensis*. Carapace and plastron of type. $\times\frac{1}{6}$.

502. Carapace. *c. p.* 1, *c. p.* 2, first and second costal bones; *n.* 1, *n.* 2, neurals; *m. s.* 3, *m. s.* 4, third and fourth marginal scutes.
503. Portion of plastron.

and third neurals, and a portion of the first. The plastron is represented from the front to near the hinder border of the hypoplastron.

In the crushing that has affected the shell there has occurred a slipping of parts near the midline. The first costal of the left side overlaps a portion of the first neural. The second and third neurals retain their original relations with the second and third costals of the right side, but overlap the proximal ends of those of the left side. The three next costals of the left side overlap and hide the corresponding neurals. Hence, only the second and third neurals and a portion of the first are to be seen.

An estimate based on Sinclair's description and illustrations and the assumption that the proportions of the species are about as they are in *Stylemys nebrascensis* shows that the carapace had a length of about 405 mm. and a width of about 400 mm., being thus nearly as broad as long. The bridge peripherals of the left side show distinctly in Sinclair's figure, here reproduced, but this is probably due to the crushing of the specimen toward the right side. On the other hand the peripherals in front of these show hardly as much of their width as might be

expected. No part of the nuchal appears. The first neural was wider than the second, and in contact with the second costal. Its greatest width was near 64 mm., while the second has measured 55 mm. in width. As in some specimens of *S. nebrascensis* and in probably all individuals of the John Day species of the genus, the third neural was tetragonal. Corresponding to this condition, the third costal was in contact with the second, third, and fourth neurals.

Costal.	Proximal end.	Distal end.
2	52±	42±
3	68	42
4	55	67
5	52	37
6	38±	51±

The costals are only slightly modified as respects the widths of the opposite ends of each. The measurements shown in the table taken from Sinclair's description and illustration show the extent of the modification.

The carapacial scutes resembled closely those of *S. nebrascensis*. An estimate makes the first vertebral scute to have been about 184 mm. wide in front. The second vertebral was about 108 mm. wide.

The plastron (text-fig. 503) was, according to Sinclair, broken away at the extremity of the epiplastral lip. It must therefore have been rounded. The anterior lobe had a length of about 100 mm., the base a width of 200 mm., resembling thus the anterior lobe of *S. nebrascensis*. The entoplastron is rhomboidal in form, thus resembling that of some species of *Testudo*. Its length is 81 mm., its width is 88 mm. The portion of the plastron present evidently extended backward to near the hinder border of the hypoplastron; but did not reach the inguinal notches. The bridge must therefore have had a width of at least 172 mm.

The sulci separating the scutes of the plastron are stated to be very obscure. The gulars and humerals resemble those of *S. nebrascensis*.

It appears to be quite certain that this species belongs to the genus *Stylemys*. It appears to differ from all the others in having a very broad first neural, which comes into contact with the second costal bone, and in having the entoplastron more pointed behind. From the known John Day species it differs in having the costal bones less wedge-shaped.

Genus TESTUDO Linnæus.

Carapace extensively joined to plastron by suture. Inguinal buttresses rising little, if any, above the costo-peripheral sutures. Second and fourth neurals usually octagonal; the third and fifth usually quadrangular. Epiplastral lip usually projecting abruptly from the general contour of the anterior lobe. Plastron notcht behind. Crushing-surfaces of jaws with longitudinal ridges and grooves. No median longitudinal ridge in front of the choanæ. Digits much shortened and foot club-shaped.

Type: *Testudo græca* Linnæus.

From both *Hadrianus* and *Stylemys* this genus is distinguisht by the much higher grade of differentiation which has been attained by the elements of the shell. From *Stylemys* it is further distinguisht, as it is also from *Gopherus*, in having no longitudinal ridge in the midline of the upper jaw in front of the choanæ. Some living species have the neurals and costals little more differentiated than in *Stylemys*, and in *T. inusitata*, described below, none of the neurals is octagonal or quadrangular.

Analysis of the Known North American Fossil Species of Testudo.

A[1]. Oligocene species:
- *a*. Titanotherium beds.
  - 1. Peripheral sulci deeply imprest; epiplastral lip more than twice as wide as long .. *brontops*
  - 2. Costals very thick; deeply imprest by lines of growth of the horny scutes ..... *exornata*
- *aa*. Oreodon beds.
  - 3. Lip nearly as wide as long; its sides parallel ..... *thomsoni*
  - 4. Shell flattened; no octagonal neural; epiplastral lip abruptly projecting, tootht in front ..... *laticunea*
  - 5. Lip truncated, three times as wide as long ..... *ligonia*
  - 6. Lip truncated, short; pectoral scutes about one-fourth as wide as abdominals .. *amphithorax*
  - 7. Lip square; the gulars not reaching the entoplastron ..... *quadrata*
  - 8. Lip narrow and wedge-shaped ..... *cultrata*

A^2. Lower Miocene species:

9. Lip prominent, twice as wide as long, and nearly as thick as long ..... *peragrans*
10. Pygal convex up and down on upper side ..... *arenivaga*
11. Lip not greatly projecting; pectoral scutes nearly half as wide on midline as abdominals ..... *vaga*
12. No 4-sided or 8-sided neurals; pectoral scutes about one-fifth as wide as abdominals ..... *emiliæ*

A^3. Deep River and Pawnee Creek (Middle Miocene) species:

13. Lip not projecting far; pectorals only one-seventh the width of the abdominals ... *farri*
14. Neurals as in *T. emiliæ*; the gulars reaching the entoplastron ..... *inusitata*
15. Shell broad and deprest; lip tapering; pectorals about one-third the abdominals .. *pansa*
16. Shell vaulted; pectorals one-twenty-fifth the abdominals, or less ..... *osborniana*

A^4. Loup Fork:

17. Lip abruptly projecting; pectorals one-eighteenth the width of the abdominals .... *impensa*
18. Hinder peripherals and pygal with free border flared upward; pygal narrowing toward the free border ..... *undata*
19. Pygal plane; its sides parallel ..... *klettiana*
20. Lip rounded, little projecting; resembles *vaga* of the Lower Miocene ..... *niobrarensis*
21. Strongly projecting lip; pectorals about one-eleventh the width of abdominals .. *orthopygia*
22. Skull only; consult figures ..... *gilberti*
23. First and third neurals 4-sided; second and fourth octagonal; lip prominent; pectorals about one-fifth the width of abdominals ..... *edæ*
24. First, third, and fifth neurals 4-sided; second and fourth octagonal; lip moderately prominent; pectorals one-fourth the width of abdominals ..... *hollandi*

A^5. Pliocene species:

25. Lip prominent; all the sulci deeply sunken and wide; free borders of the peripherals deeply nocht by the sulci ..... *turgida*
26. Shell broad and deprest; the vertebral scutes wider than long; shell thin ..... *pertenuis*
27. Lip prominent; truncated; pectoral scutes nearly half as wide as the abdominals .. *campester*
28. Hinder peripherals thick and with very obtuse free border ..... *obtusa*
29. Anterior lobe of plastron rapidly tapering forward; borders of lip continued in same lines; bones thick and heavy ..... *crassiscutata*

A^6. Pleistocene species:

30. Lip about four-fifths as long as wide, thick behind; notch in rear of plastron four times as wide as deep ..... *laticaudata*
31. Lip rounded; notch in rear not three times as wide as deep; borders of hinder lobe rapidly converging backward ..... *hexagonata*
32. Lip rounded but prominent; borders of hinder lobe slowly converging ..... *atascosæ*

Testudo brontops Marsh.

Plate 65, figs. 1, 2; text-figs. 504, 505.

Testudo brontops, MARSH, Amer. Jour. Sci. (3), XL, 1890, p. 179, plate viii; Vert. Foss. Denver Basin, in Mon. U. S. Geol. Surv., XXVII, 1897, pp. 523, 527, figs. 95, 96.—DANA, Manual Geol., 1896, p. 901, fig. 1516.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451; Amer. Jour. Sci., (4) XVIII, 1904, p. 272, figs. 6, 7.

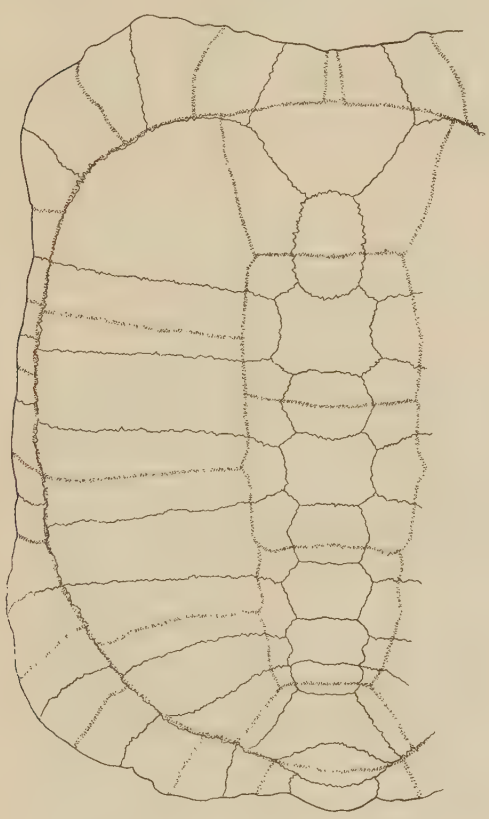
The type of this species is a fine large shell which was collected for Prof. O. C. Marsh, in the year 1888, by Mr. J. B. Hatcher, and is now in the Peabody Museum, at Yale University. It was obtained in the Titanotherium beds of Indian Creek, in the southeastern corner of Pennington County, South Dakota. No considerable parts of the shell are missing and it has been only slightly crusht. The specimen bears the record "Box 27, 1985."

In form this magnificent tortoise was broad and probably of only moderate height. The front of the carapace (plate 65, fig. 1; text-fig. 504) is somewhat concave in outline, the lateral angles broad, rounded and flaring upward. The sides were nearly perpendicular. The hinder border is broadly rounded, with the peripherals over the limbs considerably flaring and with the pygal incurved toward its free border. Where the sulci cross the free borders of the peripherals the latter are somewhat notcht; and where they cross the borders of the carapace above the bridges they lie in grooves so deep that the interspaces appear to be strongly swollen. The free borders of all the peripherals come down to an acute edge. The length of the carapace is 711 mm.; the greatest width is 651 mm.

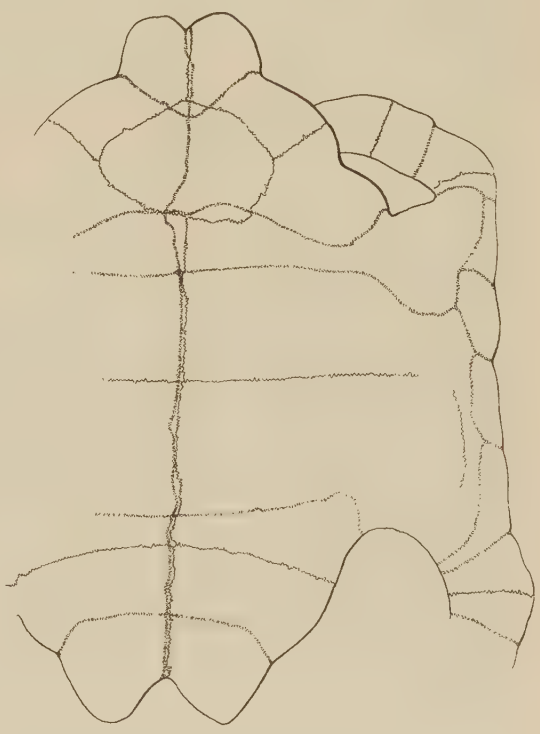
The nuchal has probably a width of about 125 mm. along the front border, but here the sutures are indeterminable. The greatest width is 175 mm. and the length along the midline 150 mm. The first neural is oval; the second and the fourth octagonal; the third, hexagonal. The fifth was probably hexagonal, but a considerable portion of it appears to have been crusht down beneath the fourth. The sixth, seventh, and eighth are approximately hexagonal. The table gives the dimensions of the neurals.

Dimensions of neurals.			Dimensions of costal bones.		
No.	Length.	Width.	No.	Width of upper end.	Width of lower end.
1	127	75	2	56	106
2	79	100	3	100	73
3	95	97	4	56	90
4	73	100	5	94	56
5	..	63	6	61	95
6	62	87	7	40	75
7	50	78	8	43	62
8	37	72			

The anterior suprapygal is bifurcate, having a total height of about 87 mm., and inclosing between its right and left limbs the second suprapygal. The latter has a height of 84 mm. on the midline and a breadth of 125 mm. The costals are alternately wider and narrower at their upper ends and vice versa at their lower, but the amount of the differentiation is not great. Omitting the first the dimensions are given in the table above.



504.



505.

FIGS. 504 AND 505.—*Testudo brontops*. Carapace and plastron of type. ×⅛.

504. Carapace. 505. Plastron.

The upper ends of the third costals have been somewhat injured by crushing. The proximal ends of the fifth costals also have been damaged so that their exact width is uncertain. On the right side the greater portion of the fifth costal has been pushed down out of sight.

The second peripheral occupies about 150 mm. of the free border, and extends backward 110 mm. It is nearly flat above, concave beneath, and attains a thickness of 37 mm. The

bridge peripherals extend upward about 140 mm. above the slight carina which joins the border of the third peripheral with that of the seventh. From the seventh peripheral the height of these bones diminishes to the pygal. The latter has a height of 82 mm.; a width of 125 mm. at the upper border, and of 100 mm. at the free border.

The nuchal scute is 56 mm. long and only 7 mm. wide. The first vertebral has a width of 230 mm. in front and a length of 165 mm. The transverse extent of the vertebral scutes is considerably less than that of the costals. The width of the second is 190 mm.; that of the third probably about the same, but its lateral boundaries are mostly hidden; that of the fourth is 150 mm.; that of the fifth, at the posterior end, is 180 mm. The second costal scute has a transverse extent of 230 mm.

The sulci between the anterior marginal scutes lie in grooves; and, as they approach the free border, they curve toward the midline. Those of the bridge region are directed forward at their lower ends. The lower ends of these sulci and the longitudinal ones between the marginal and the plastral scutes also lie in deep valleys. The supracaudal scute is 175 mm. wide at its lower end. Its upper end overlaps the posterior suprapygal bone.

The plastron (plate 65, fig. 2; text-fig. 505) is quite concave, a condition which indicates that the animal was a male. The length of the anterior lobe is 222 mm.; its width is 380 mm. The anterior lip extends beyond the border of the carapace about 60 mm. It projects boldly from the general contour of the anterior lobe and its lateral borders converge somewhat as they approach the bilobed anterior border. The length of the lip beyond the points where the gulohumeral sulci cross the free borders of the epiplastra is 56 mm.; the width at the base is 135 mm. A broad and deep groove occupies the median line of the lip and ends in the notch in the front of the lip. The greatest thickness of the lip is 50 mm. The superior surface is somewhat convex from side to side. In all probability there is an excavation in the hinder portion of the lip above, but the matrix has not been removed.

The entoplastron has a width of 175 mm. and a length of 120 mm. The bridge is 300 mm. wide. The hinder lobe has a length of about 175 mm. and a width, at the base, of 370 mm., or slightly less. The notch in the rear is about 40 mm. deep and about 100 mm. wide. The xiphiplastra are each 165 mm. long. Just behind the inguinal notch the border of the posterior lobe is 50 mm. thick and forms a nearly perpendicular face. Further backward the steepness of the slope and its height are rapidly reduced.

The sulci bounding the dermal scutes are deeply impressed. Those bounding the gular scutes lie at the bottom of deep valleys, which proceed forward from the entoplastron, one to each side of the base of the lip and one to the front on the midline. The gulars encroach somewhat on the front of the entoplastron. The humero-pectoral sulcus starts on each side at the axillary notch, runs inward and backward, then inward and forward. Near the midline it is somewhat irregular, bending in its course slightly backward. On the left side it traverses the border of the entoplastron. The width of the pectoral along the midline is between 50 mm. and 60 mm. The abdominals occupy 240 mm. of the midline; the femorals, 100 mm; and the anals, about 60 mm.

A large specimen of *Testudo* was collected in the Titanotherium beds of South Dakota by the party from the American Museum in 1904. It appears to belong to this species.

This species is especially interesting because of its being the oldest known North American species of the genus. *T. ammon*, described from the Upper Eocene of Egypt, appears to be still older.

Testudo thomsoni sp. nov.

Plate 66, figs. 1–5.

The only remains of this species at present known were obtained in 1904, by Mr. Albert Thompson, of the American Museum of Natural History, at Corral Draw, in Ziebach County, South Dakota. They were found in a block of limestone which had come from the Lower Oreodon beds. The parts secured are the skull, the greater portion of the anterior lobe of the plastron, some cervical vertebræ, and parts of the left foreleg. These bear the catalog number 3940. Other portions of the skeleton were in the block; but they were not secured, because they were supposed to belong to the very common species, *Stylemys nebrascensis*.

belongs to this specimen it must be the eleventh, and the height of the peripherals was rapidly reduced from the ninth, inasmuch as the supposed eleventh is only 64 mm. high. Its thickness is 26 mm. The upper surface is nearly plane, while the inferior is convex in section at right angle with the free border. Fig. 521 is a section taken near the posterior sutural border. Cope's measurements indicate that he had one other hinder peripheral, but this is not now present. Curiously enough, his dimensions apply exactly to the first right peripheral.

The sulci are narrow and sharply imprest. The nuchal scute is 40 mm. long and only 9 mm. wide. On the lower side of the bone this scute has a posterior width of 25 mm. The sulcus between the first and second marginals is 62 mm. long. The anterior width of the first vertebral has been 58 mm.

Professor Cope figured the left epiplastron, as seen from below; but he erroneously stated that the view is from above. A figure is here presented of the bone as seen from above (fig. 522). The anterior lip projects abruptly from the general outline of the anterior lobe for a distance of 35 mm. The anterior border of the lip is truncate, with the angle between it and the lateral border clipt off. The whole free edge of the epiplastron is acute, except near the midline, where it is slightly rounded. From the free edge of the lip the bone thickens

FIGS. 523–525.—*Testudo ligonia*. Parts of plastron of type. $\times\frac{1}{2}$.

523. Fragment of left hypoplastron, lower surface. *a*, suture with seventh peripheral; *bc*, suture with xiphiplastron; *bd*, suture with right hypoplastron.
524. Section across left hypoplastron just in front of union with xiphiplastron. *a*, outer border; *b*, border at midline.
525. Fragment of hyoplastron. Shows suture, *cd*, for union with entoplastron; *pec*, pectoral scute.

backward until it attains a thickness of 32 mm.; then suddenly drops off to 17 mm. The portion of the epiplastron in front of the gulo-humeral sulcus projects nearly horizontally forward, while the portion behind it ascends to meet it. On the lower side there is a decided angle between the two portions. The sulcus runs forward in this angle.

The fragment of hypoplastron (fig. 523) extends from the inguinal notch to the longitudinal median suture and backward to the suture with the xiphiplastron. The base of the hinder lobe is shown to have been 188 mm. wide. From the buttress a rounded ridge (fig. 524) descended which past backward on the summit of a wall surmounting the border of the lobe. The outer face of the wall is convex and 30 mm. high. From the summit the inner face slopes gradually to the midline. The lower surface of this bone displays faint grooves on the area of the femoral scute.

The sulci of the plastron, like those of the carapace, are narrow and sharply impressed. The gular scutes encroacht on the epiplastra. The humero-pectoral sulcus (fig. 525) crost the midline about 8 mm. behind the entoplastron. The pectorals are 18 mm. wide at the midline.

Under the species *T. quadrata* will be found mention of characters which distinguish it from the present species.

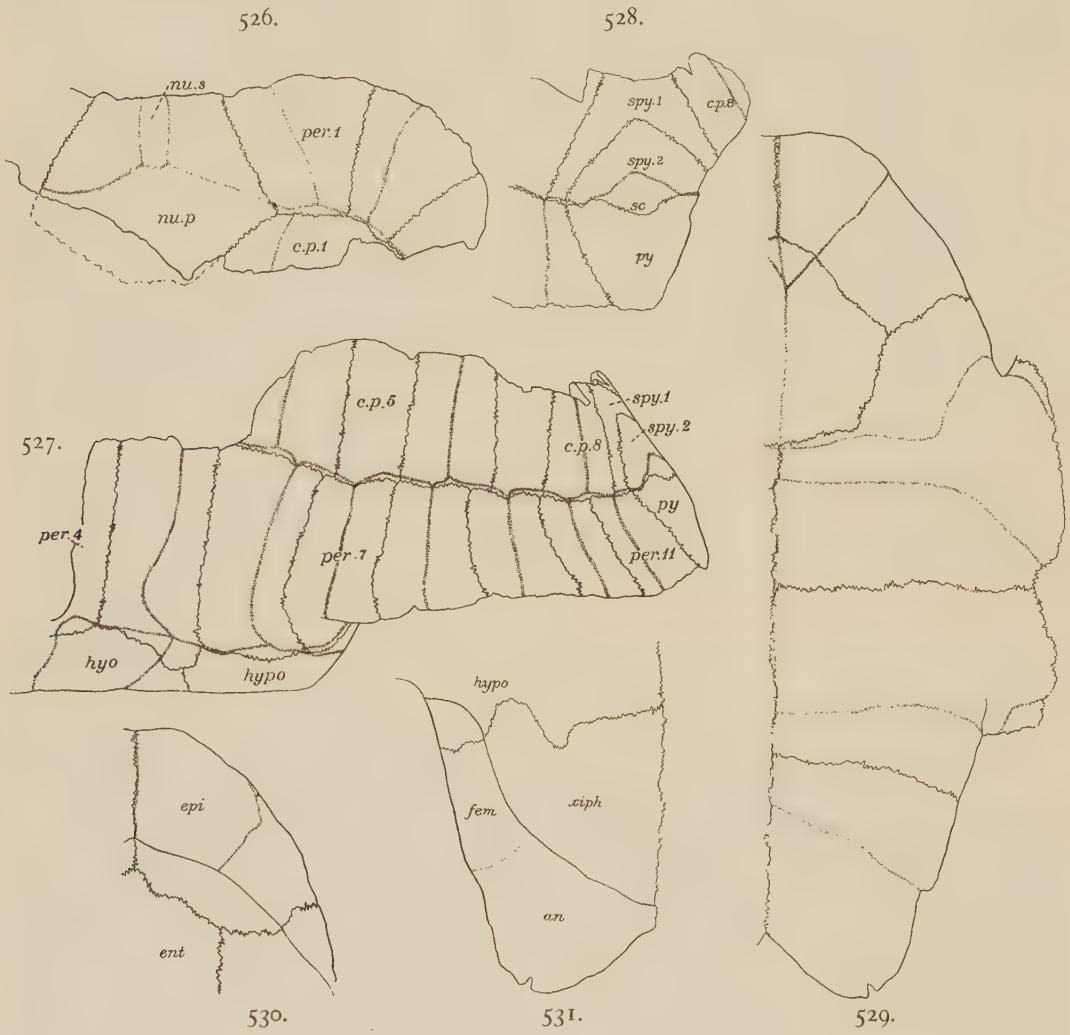
Testudo amphithorax Cope.

Figs. 526–531.

Testudo amphithorax, COPE, Palæont. Bull. No. 15, 1873, p. 6; Synop. New Vert. Tert. Colorado, 1873, p. 19; Ann. Rep. Geol. and Geog. Surv. Terrs., 1873 (1874), p. 511; Vert. Tert. Form. West., 1884, p. 767, plate lxi, fig. 4.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

Of this species Cope possest portions of 2 individuals which display the anterior lobe of the plastron, and another which lackt this lobe. These specimens are now in the American Museum of Natural History. The portions of the plastron which Cope figured are included

under the museum's No. 1145, but this author states that the anterior lobe does not belong to the same individual as the posterior. No other parts of the skeleton belong with these plastral bones.



FIGS. 526–530.—*Testudo amphithorax*. Portions of shell.

526. Front of carapace. ×½. No. 1139 A. M. N. H. *c. p.* 1, part of first costal plate; *nu. p.*, nuchal plate; *nu. s*, nuchal scute; *per.* 1, part of first costal plate.

527. Lateral view of part of shell. ×¼. No. 1139 A. M. N. H. *c. p.* 5, fifth costal plate; *hyo*, hyoplastron; *hypo*, hypoplastron; *per.* 4, *per.* 7, *per.* 11, fourth, seventh and eleventh peripherals; *py*, pygal; *spy.* 1, *spy*, 2, first and second suprapygals.

528. Rear of carapace. ×¼. No. 1139 A. M. N. H. *c. p.* 8, eighth costal plate; *sc*, supracaudal scute; *spy.* 1, *spy.* 2, first and second suprapygals.

529. Plastron. ×¼. Anterior half from No. 1139 A. M. N. H.; posterior half from No. 1147 A. M. N. H.

530. Upper surface of anterior end of plastron. ×¼. No. 1139 A. M. N. H. *ent*, entoplastron; *epi*, epiplastron.

531. Upper surface of left xiphiplastron. ×¼. No. 1147 A. M. N. H. *an*, anal scute; *fem*, femoral scute; *hypo*, hypoplastron; *xiph*, xiphiplastron.

Another specimen, No. 1139, includes the anterior half of the plastron; a little more than the right half of the anterior rim of the carapace; a little more than the left half of the posterior rim, together with most of the bridge peripherals of that side and the distal ends of several costals; the pygal and both suprapygals; the greater portion of the shoulder-girdle; and unimportant parts of the pelvis. What appears to be Cope's third specimen consists of the hypoplastron and the xiphiplastron of the left side. It has the number 1147. Most of the

That which distinguishes this species from those of the genus *Stylemys* is the prominent epiplastral lip (plate 66, fig. 1). How long this was originally it is now impossible to say, for the anterior end has been broken away. The portion remaining extends 32 mm. beyond a line joining the anterior ends of the gulo-humeral sulci. The thickness of the broken end is 26 mm. It appears probable therefore that the lip was at least 60 mm. long. Its width at the base is 80 mm. The lower and upper faces are convex from side to side. The free edges are acute, as are also the epiplastral edges behind the lip. Opposite the anterior ends of the gulo-humeral sulci the thickness of the lip is 32 mm. Seen from below, the plastron rises toward the lip, so that the latter projects on a slightly higher plane. Seen from the upper side, the lip is carried backward 20 mm. behind the line joining the anterior ends of the gulo-humeral sulci. It attains a thickness of 35 mm., then slopes off rapidly to the entoplastron.

The entoplastron has a length of 93 mm. along the midline and a width of 107 mm. Its form is approximately rhomboidal.

The gular scutes extend on the entoplastral bone. The sulci are deeply imprest. Altho the plastron is present at the midline a distance of 40 mm. behind the hinder border of the entoplastron, there is no certain trace of the humero-pectoral sulcus.

The skull is in a good state of preservation. The premaxillæ are missing, as are most of the right maxilla, the tip of the left dentary, and the anterior half of the right dentary.

The length of the skull (plate 66, figs. 2–4) from the upper border of the nasal opening to the occipital condyle is 85 mm. The breadth just in front of the tympanic cavities is 62 mm.; between the outer borders of the articulation of the lower jaw, 60 mm. In front of the temporal fossæ the upper surface of the skull is quite flat. Seen from the side the upper surface of the skull is nearly straight from the snout to the end of the supraoccipital. The interorbital space is 23 mm. wide. The jugal arch has a height of 13 mm.; the postorbital arch a width of 10 mm. The frontals furnisht a small portion of the rim of the orbit. The antero-posterior diameter of the orbit is 24 mm.; the perpendicular diameter, 18 mm. The roof of the mouth is moderately vaulted, and is traverst along the midline by a sharp ridge. The triturating surface of the upper jaw has a longitudinal rough ridge and a less conspicuous inner ridge. Posteriorly the palate is reduced to a width of 13 mm.

The dentary bone (plate 66, fig. 5) is channeled from the coronoid process to near the symphysis, to receive the dentated ridge of the upper jaw. The lower jaw is 19 mm. high at the coronoid process.

The distal half of the left humerus is present. The width of the distal end is 54 mm. The left radius has an extreme length of 92 mm. A claw phalange has a length of 20 mm. and a width of 16 mm.

The cervical vertebræ are more or less damaged. One has the centrum 40 mm. long.

This was a large turtle, the length of the carapace being estimated at about 625 mm.

Thru the kindness of Dr. S. W. Williston, of the University of Chicago, the writer has been permitted to examine a testudinid skull which was collected in 1894 by Dr. George Baur. It was obtained in the same locality as the specimen above described and probably in the same beds. The skull is somewhat fragmentary and lacks the symphyses of the upper and lower jaws. It appears to have belonged to *T. thomsoni*, but it presents some differences. The orbit is more nearly circular than in the type; but the type may have suffered some distortion in this region. The upper longitudinal outline of the skull of Dr. Baur's specimen is not so straight, the supraoccipital crest not rising so high. The skull is that of a smaller specimen and the depression of the crest may be due to an earlier stage of growth, to sex, or to individual variation.

Testudo exornata Lambe.

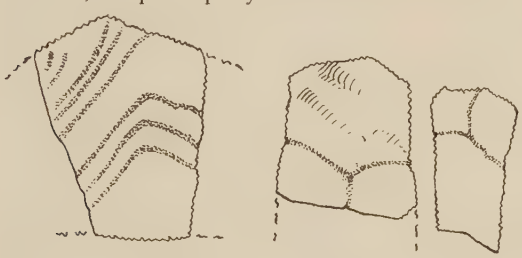
Plate 66, figs. 6, 7; text-figs. 506–508.

Testudo exornata, LAMBE, The Ottawa Naturalist, XIX, 1906, p. 187, plate iii, figs. 1–3.

All the known specimens of the present species belong to the Geological Survey of Canada. They consist wholly of fragments of costal plates, which were collected in 1904, by Mr. Lawrence M. Lambe, vertebrate paleontologist of the Canadian Survey, in the Oligocene beds of

the Cypress Hills, Assiniboia. These costals are remarkable for their thickness, the deeply imprest sulci, and the strongly markt lines of growth of the horny scutes.

Figs. 6 and 7 of plate 66 represent the distal half of the left fifth costal, which is taken by Mr. Lambe as the type of the species. Fig. 6 shows the outer surface. This is 12 mm. wide at the upper end, 10 mm. at the lower. It might be taken for the bone of a young animal were it not for the great thickness. The anterior sutural border has a thickness of a little more than 4 mm. From this border the bone thickens rapidly, so that the posterior border, at the lower end of the bone, is 8 mm. thick. Seen from the inner surface (fig. 7) the bone presents, on the hinder half of its width, a prominent half-ridge, which was evidently completed on the succeeding costal. The larger portion of the ridge has been on the sixth costal, and has been developt to receive the inguinal buttress of the plastron. It looks indeed as if this buttress had ascended about 15 mm. above the border of the costals and had been articulated with both the fifth and the sixth, but principally with the latter. So far as the writer is aware, in other species of *Testudo* the buttress articulates only with the sixth costal. At the lower end of the fifth costal is a pit for a process of the seventh peripheral. It is evident that this costal was much broader at the proximal end than at the distal.



506. 507. 508.

FIGS. 506–508.—*Testudo exornata.* Costals of type. ×1.

506. Fragment of first costal.
507. Proximal end of sixth costal.
508. Proximal half of third or fifth costal.

There is present a portion of the left first costal plate (fig. 506). In this figure the upper border was directed toward the head, the right hand border toward the first neural. At the upper end the fore-and-aft width of the bone was about 30 mm. From this it is estimated that the length of the carapace was about 200 mm. At its posterior border the bone is 4.5 mm. thick. On the inner surface is a ridge which past upward into the head of the rib. The outer surface of the bone is markt by the lines of growth of the first costal scute. Fig. 507 represents the outer surface of the proximal end of another costal, probably the sixth costal of the left side. Where the bone joined the sixth neural it is 8 mm. thick. The sulci are narrow, but deeply imprest. The outer surface shows the lines of growth of the scutes. At its upper end the bone is 15 mm. wide and appears to have expanded toward the distal end.

Fig. 508 represents a costal of a young individual, evidently the third or the fifth, probably the fifth of the right side. The width at the upper end is 12 mm. The width at the distal end of the fragment, probably about the middle of the length of the costal, has increased to 9 mm. Its thickness is a little more than 3 mm. On the under side of the bone is found the base of a rather well-developt rib-head.

Testudo laticunea Cope.

Plate 67, figs. 1, 2; text-figs. 509–515.

Testudo laticunea, COPE, Palæont. Bull. No. 15, 1873, p. 6; Synop. New Vert. Tert. Colorado, 1873, p. 19; Ann. Rep. Geol. and Geog. Surv. Terrs., 1873 (1874), p. 511; Vert. Tert. Form. West, 1884, pp. 762, 765, plate lxi, figs. 1, 1*a*.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

In his original description Professor Cope states that he had in his possession several specimens of this species, but he does not designate any as the type. In his description of 1884 one individual in a good state of preservation was used as the basis of the description and was figured. This must now be regarded as the type, especially since the other specimens occurring in the Cope collection are very fragmentary. This type is now in the American Museum of Natural History and bears the number 1160. All of Cope's specimens were obtained in the Oligocene beds at the head of Horse Tail Creek, in northeastern Colorado. These deposits belong to the level known as the Oreodon beds.

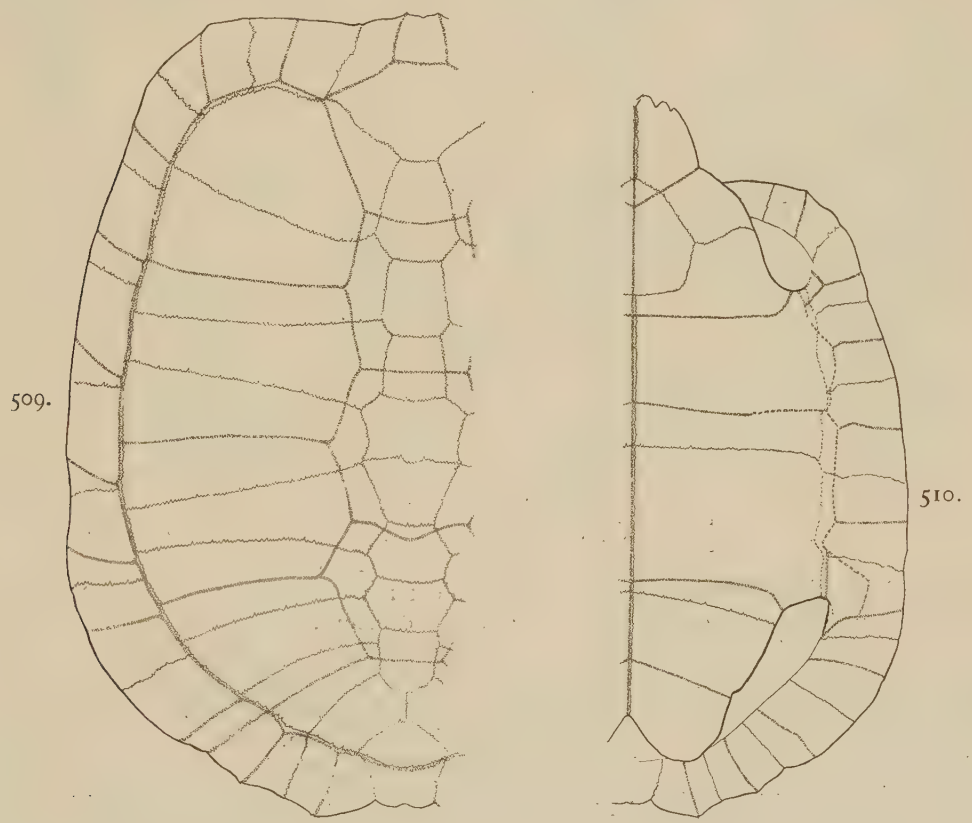
The specimen is slightly distorted, somewhat fractured, and some portions are missing. A fracture extends along the midline of the anterior part of the carapace and the elements of

the right side have been thrust forward about 10 mm. in front of those on the left. Some portions of neurals, costals, and peripherals are missing, especially on the right side, but all parts are represented on one side or the other. The outer ends of the hyoplastra are wanting and part of the outer end of the left hypoplastron.

The species was a broad and rather deprest one, and in many respects it resembled the recent *Gopherus polyphemus*. The following table presents some of the dimensions. When Cope's measurements differ they are added in parentheses.

Length of carapace	420 (408)	Width of anterior lobe	200
Width of carapace	356	Greatest length of posterior lobe	120
Greatest length of plastron	440	Width of base of posterior lobe	210 (200)
Length of anterior lobe	132		

The anterior border of the carapace (plate 67, fig. 1; text-fig. 509) is truncate; the posterior border between truncate and rounded. The free edge is everywhere acute. Where the



FIGS. 509 AND 510.—*Testudo laticunea*. Carapace and plastron of type. $\times\frac{1}{4}$.

509. Carapace. 510. Plastron.

sulci between the marginal scutes cross the free border there is present a tooth or mucro. The height of the bridge peripherals was about 85 mm.; while the extent of the corresponding costals, transverse to the animal, was about 145 mm. The greatest thickness of the first peripheral is 18 mm. The nuchal bone occupies 62 mm. of the free border, and its greatest width is 95 mm. The hinder peripherals have a slight flare. The eighth has a height of 70 mm. and a thickness of 22 mm. The pygal has a length of 34 mm. along the midline, a transverse extent of 57 mm. at the upper border, and of 45 mm. along the free border. The first suprapygal is bifurcate and comes into contact with the eleventh peripheral of each side, but not with the pygal. The second pygal is broader than long.

The neurals have not attained so high a degree of differentiation of form as they have in most of the species of the genus. None of the series is octagonal. All are hexagonal, except

the third, which is nearly square, and the fifth, which is rhomboidal. The table gives the greatest length and width of each neural.

The costal plates have undergone considerable differentiation in form. The second, fourth, sixth, and eighth have narrow proximal ends and wide distal ends; while the third and fifth have wide proximal and narrow distal ends. The third comes into contact with 3 neurals, the fifth with only 2. It is not unlikely, however, that other individuals will present variations in the forms of the neurals and costals.

Neural.	Length.	Width.
1	56	46
2	42	40
3	33	37
4	35	50
5	39	48
6	32	45
7	28	46
8	28	29

The free borders of the plastron (plate 67, fig. 2; text-fig. 510) are acute. The dimensions of the lobes are given in the table of measurements. The anterior lip projects beyond the front of the carapace about 50 mm. The base is 87 mm. wide from the crossings of the gular sulci over the free border. The length of the lip is 43 mm. The sides converge somewhat, and the rounded anterior border is furnisht with 6 blunt teeth. The upper surface of the lip is convex, and it rises backward until the thickness becomes 33 mm. The hinder face of this thickening is somewhat excavated. The entoplastron is pointed in front, broad and somewhat rounded behind.

The posterior lobe ends behind in 2 broadly rounded apices, which inclose a deep and sharp notch. The borders of the apices are toothed. Just behind the inguinal notch the border of the hypoplastron forms a wall about 25 mm. high. From the summit of this there is a slope to the free edge.

The sulci of the carapace are narrow grooves with raised edges. The nuchal scute has a width of 28 mm. behind, but it is narrower in front. The sulci on the bridges are directed downward and forward. The vertebral scutes have considerably less lateral extent than do the costals. The accompanying table presents in millimeters the greatest length and width of the vertebrals.

Vertebral.	Length.	Width.
1	86	102
2	80	80
3	81	85
4	75	82
5	90	135

The gular scutes encroach on the entoplastron. The humeral scutes meet along the midline for 76 mm.; the pectorals, 56 mm.; the abdominal, 118 mm.; the femoral, 52 mm.; the anal, 36 mm.

Of the other parts of the skeleton there are present the humerus, the pelvis, both femora, and the right tibia. The humerus (fig. 511) lacks the distal end. It was bent more strongly than that of *Gopherus polyphemus*, and the tuberosities are more strongly developt. The pelvis is represented by figs. 512 and 513. The ischial tuberosities are pointed, and their apices are 45 mm. apart. The extremity of the lateral and anterior pubic processes are missing. The ilium has the proximal end much broadened antero-posteriorly, it being about 44 mm. The femur (figs. 514, 515) is unusually straight. The digital fossa is rather deep.

In the Marsh collection at Yale University there is a large specimen which is to be referred to this species. It was collected for Professor Marsh by Mr. J. B. Hatcher in the year 1889, in the Titanotherium beds of South Dakota. It is at present designated by the receipt numbers "2054, box 1." The specimen was flattened somewhat during fossilization, but it was probably originally of deprest form. Most of the hinder peripherals are now missing, as is also the plastral lip. The second neural of this individual is octagonal, but the sides which are in contact with the first and third costals of each side are very short. The third neural is approximately square. All the others are hexagonal. The two suprapygals are about as in the type.

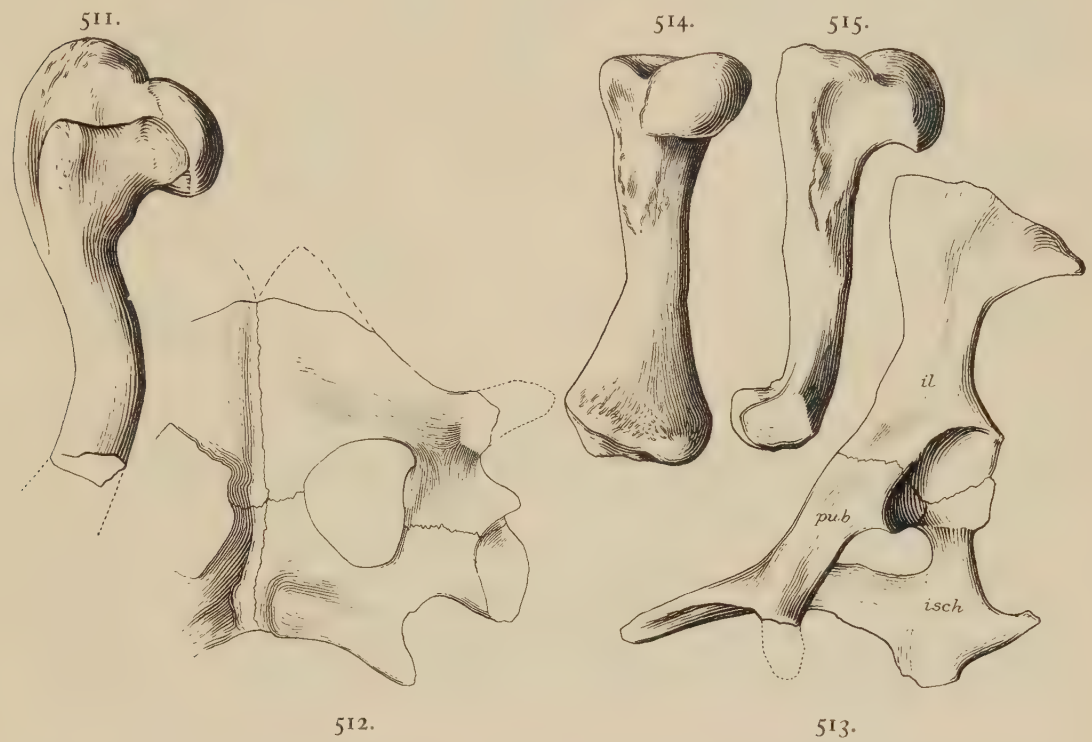
The costal plates are strongly modified, having their proximal ends alternately narrow and wide, while the distal ends are alternately wide and narrow. Their dimensions are presented in the table herewith.

Costal.	Width upper end.	Width lower end.
2	41	82
3	44	46
4	38	85
5	38	25
6	35	55
7	28	33

The first peripheral has an extent, backward from the free edge, of 50 mm. The bridge peripherals rise a distance of 88 mm. above the carina which joins the free border of the third peripheral with that of the seventh. On some of the free peripherals there is found a mucro, as in the type specimen.

The plastron shows no especial differences when compared with that of the type. The apices of the xiphiplastron are not notcht, in this way differing slightly from those of the original specimen.

No. 238 of the Carnegie Museum, Pittsburg, is a third known specimen of this species. It is a complete shell, which was collected by Prof. J. B. Hatcher from the Oreodon beds of the Oligocene, at Warbonnet, Sioux County, Nebraska. The carapace is 375 mm. long and 325 mm. wide. Like the other specimens, it is deprest. When compared with the type



FIGS. 511–515.—*Testudo laticunea*. Humerus, femur, and pelvis of type. $\times\frac{2}{3}$.

511. Proximal portion of left humerus.
512. Pelvis, seen from below.
513. Pelvis, seen from left side. *il*, ilium; *isch*, ischium; *pub*, pubis.
514. Left femur, dorsal surface.
515. Left femur, tibial border.

there appear to be no important differences. The sulci run along the summits of low ridges, as in the type. Those of the hinder peripherals end at the free margins of the latter on projecting points.

The only important feature of the plastron is found in the shape of the anterior lobe. This is more wedge-shaped than in the type specimen, the convexity of the free border, from the axillary notch to the gulo-humeral sulci being much less pronounct. The epiplastral lip is notcht and tootht in front like that of the type.

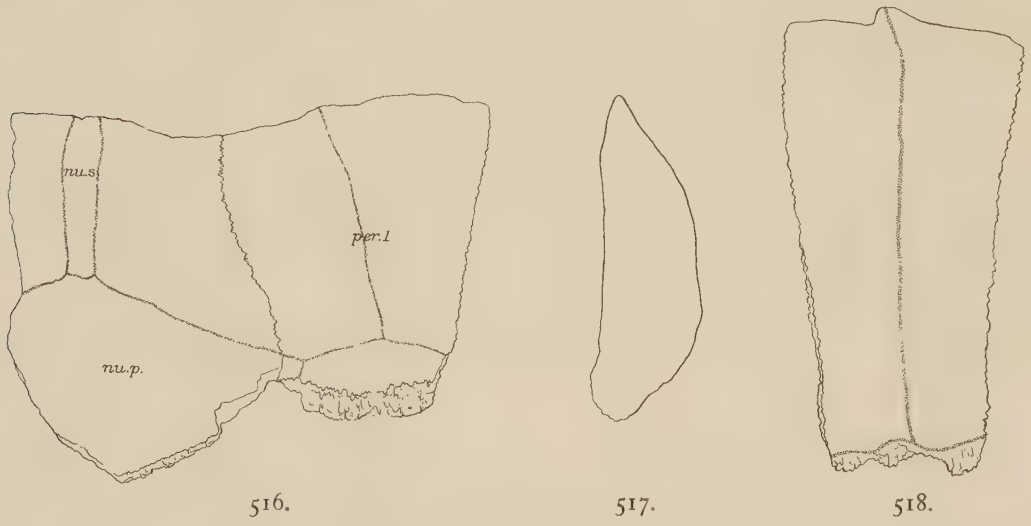
Testudo ligonia Cope.

Figs. 516–525.

Testudo ligonius, COPE, Palæont. Bull. No. 15, p. 6, 1873; Synop. New Vert. Tert. Colorado, 1873, p. 19; Ann. Rep. U. S. Geol. and Geog. Surv. Terrs., 1873 (1874), p. 511; Vert. Tert. Form. West., 1884, pp. 762, 766, plate lxi, figs. 2, 3.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

This species was based on a single imperfect individual, and no others have yet been secured. The type belongs to the Cope collection in the American Museum of Natural History and bears the number 1148. It was collected by Cope in 1873, in the Oreodon beds of the White River deposits, at the head of Horse Tail Creek in northeastern Colorado. It consists of a portion of the nuchal bone, the first and probably the ninth right peripherals, the left epiplastron, a part of the left hyoplastron, and the left hypoplastron in the region of

the inguinal notch. Another peripheral is present which has the same texture and general appearance as the other bones, but it possibly belongs to another turtle. If pertaining to this skeleton it can be only the eleventh.

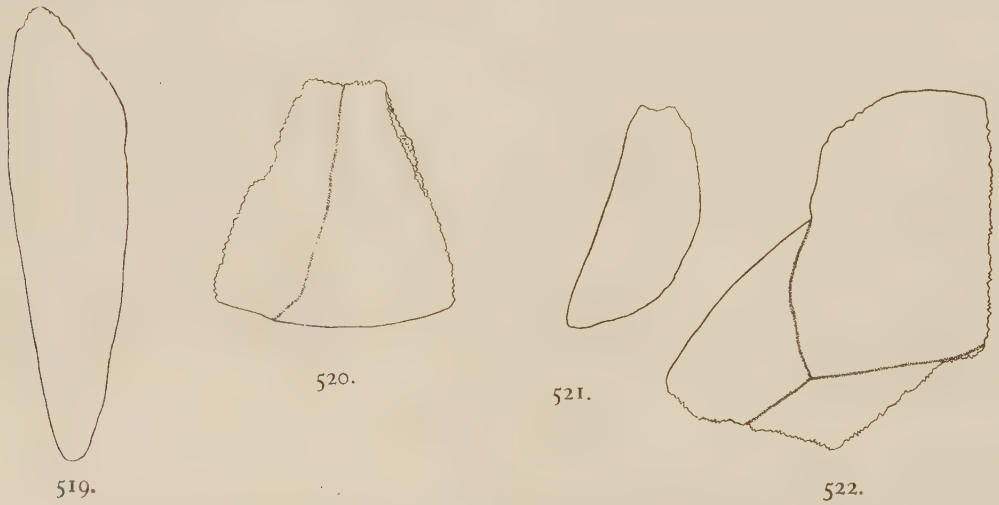


516. 517. 518.

FIGS. 516–518.—*Testudo ligonia*. Parts of carapace of type. $\times\frac{1}{2}$.

516. First peripheral and part of nuchal. *nu. p*, nuchal plate; *nu. s*, nuchal scute; *per*, 1, first peripheral.
517. Section of first peripheral near union with second. Upper surface toward the left.
518. Ninth peripheral of type.

The nuchal (fig. 516) had a length, in the median line, of about 100 mm.; a width, at the free border, of 70 mm.; and a maximum width of 108 mm. The greatest thickness, at the midline, is 21 mm. The portion occupied by the first vertebral scute stands at a distinct angle with that in front of it. The first peripheral has a fore-and-aft extent of 81 mm., of which 75 mm. has been exposed on the upper surface. The thickness of the sutural border next the



519. 520. 521. 522.

FIGS. 519–522.—*Testudo ligonia*. Peripherals and epiplast of type. $\times\frac{1}{2}$.

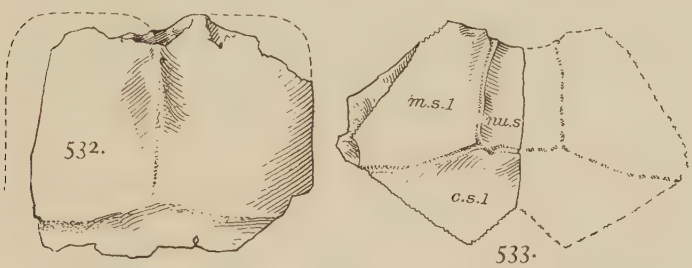
519. Section of ninth peripheral, near union with eighth.
520. Supposed eleventh peripheral.
521. Section of eleventh peripheral, near union with tenth.
522. Upper view of left epiplastron.

second peripheral is 26 mm. The free borders of these bones are acute. Fig. 517 is a section taken near the articulation with the second peripheral.

The ninth peripheral (fig. 518) is high and narrow, the height being 92 mm., the width along the free border 24 mm. There is no flare, and the free border is acute. The greatest thickness, at a point 73 mm. above the free border, is 24 mm. Fig. 519 is a section taken near the anterior sutural border. The free edge is acute. If the remaining peripheral (fig. 520)

All of the sulci present on the fragment are deeply imprest.

The fragment of the nuchal (fig. 533) is not very instructive. It comes to an acute edge in front, and thickens backward to 31 mm. Portions of 3 scutes are shown—the nuchal, the first peripheral, and the first vertebral. The nuchal had a length of 41 mm. Its width is indeterminable, but exceeded 17 mm. On the lower side of the bone the nuchal scute was considerably wider than above. Nothing can be determined regarding the dimensions of the other scutes. The sulci are deeply imprest and have raised borders.



FIGS. 532 AND 533.—*Testudo quadrata.* Epiplastral lip and nuchal of type. ×⅓.

532. Epiplastral lip, upper surface.
533. Portion of nuchal bone. *c. s.* 1, part of first costal scute; *m. s.* 1, part of first marginal scute; *nu. s*, nuchal scute.

In its abruptly projecting lip this species resembles somewhat *T. ligonia* found in the same region. The differences are, however, very obvious. As seen from the lower side of the plastron, the gulo-humeral sulci of *T. ligonia*, departing from the free borders of the epiplastra, run backward and inward at an angle of about 45° with the midline, to end on the entoplastron. In *T. quadrata* the gulo-humeral sulci run across the epiplastra at a right angle with the midline and do not touch the entoplastron. In *T. ligonia* the lip, as seen on the upper side, continues backward on the epiplastra a distance even greater from a line joining the anterior ends of the gulo-humeral sulci than it does in front of this line. In *T. quadrata*, on the contrary, the lip extends behind the line mentioned a very short distance.

Testudo cultrata Cope.

Testudo cultratus, COPE, Palæont. Bull. No. 15, 1873, p. 6; Synop. New Tert. Vert., 1873, p. 19; Ann. Rept. U. S. Geol. and Geog. Surv. Terrs., 1873 (1874), p. 511; Vert. Tert. Form. West, 1884, pp. 762, 763, plate lxiii, figs. 1–3; Geol. Surv. Texas, 3d Ann. Rept., 1891 (1892), p. 256.
Testudo cultrata, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

The basis of this species is said by Professor Cope to have been two imperfect specimens found by him in 1873, in the White River deposits, at the head of Horse Tail Creek, in northeastern Colorado. The level is that of the Oreodon beds, the middle of the White River. The specimens described by this author have not yet been found in the Cope collection in the American Museum nor in the U. S. National Museum. For this reason, it is thought best to reproduce here Cope's description.

Parts of two individuals of this species were obtained by my expedition of 1873.

This is the smallest of the five species of *Testudo*, having about the average size of the *Stylemys nebrascensis*. This is indicated by the costal and marginal bones which accompany the portions of plastron of both specimens. The width of the lip at the base is also less than that of any of the other species, but the length and thickness are remarkable as compared with the other dimensions. The width and thickness at the base of the lip are nearly equal; both dimensions diminish to the apex, which is obtusely acuminate. The superior face of the lip is gently convex in both dimensions. The inferior surface is plane anteroposteriorly; transversely it rises to the external edge, which is subacute. The suture of the gular scutum is directed posteriorly, giving the usual triangular form. The thickness of the lip is abruptly reduced above, where the surface descends to the mesosternal bone.

The lip of one of the specimens is fissured deeply, in an eccentric manner, on both sides of central core. Whether this or the unfissured condition is characteristic of the species or not, is uncertain. It appears to be homologous with the dentation in the lip of *T. laticuneus*.

The marginal bones are robust, and are much thickened below. The edges of those of the posterior margin are acute, while those of the anterior border are obtuse, thus differing from those of *T. laticuneus*, where they are acute. At the points where the dermal sutures reach the margin, both specimens are unfortunately broken in every instance, so that the question of notches or mucros can not be decided. The costal bones are moderately thick, and alternate in width, narrower and wider. The dermal sutures

do not display raised margins. The anal marginal bone is wedge-shaped, with the posterior margin representing a truncate apex. Its surface and margin are convex, and the anterior sutural margin is concave.

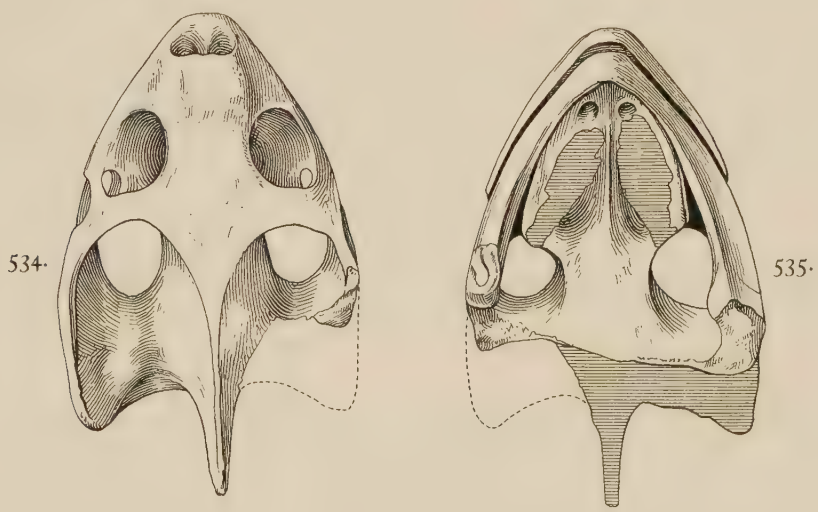
A fragment, which is in all probability the posterior lobe of the plastron, is characteristic. It is thick, and its inferior face is somewhat recurved posteriorly. The outline of the margin presents a pronounced obtuse angle, and the edge is several times abruptly notched.

Measurements of No. 1.

Diameter of half of lip:	
At base	
Vertical	0.040
Transverse	.043
Length outer edge	.056
Diameter second marginal from anal:	
Thickness	.019
Width	.030
Length free margin of anal	.026
Width of anal above	.050
Thickness of a vertebral bone	.011
Thickness of a costal at middle	.009

Found by myself near the head of Horse Tail Creek, in northeastern Colorado.

Cope has explained his fig. 1 as that of the right half of the lip seen from above. This may be correct, but it is probable that it presents the left half of the lip seen from below.



Figs. 534 and 535. *Testudo peragrans*. Skull of type. ×1.

534. Upper surface. 535. Lower surface.

Testudo peragrans Hay.

Figs. 534–538.

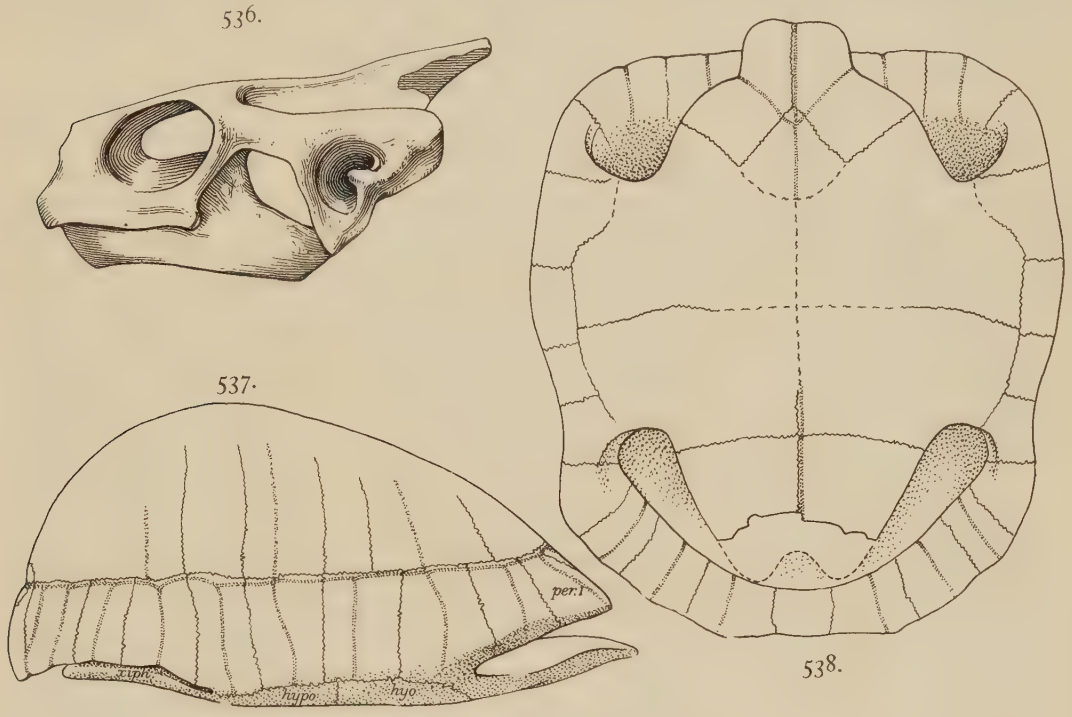
Testudo peragrans, Hay, Ann. Carnegie Mus., iv, 1906 (1907), p. 15, figs. 1–5.

The type and at present only known specimen of this species is No. 1101 of Carnegie Museum, Pittsburg, Pennsylvania. It was collected by Mr. Earl Douglass, in 1903, south of McCarty's Mountain and Big Hole River and north of Dillon, Montana. There is at present some uncertainty regarding the age of the deposits. They may be either Oligocene or Lower Miocene.

The specimen furnishes the damaged carapace and plastron and a nearly complete skull.

The skull (figs. 534–536) lacks a part of the palatal region, the occipital condyle, and the right otic region. The lower jaw is so closely cemented in its place that it is thought best not to attempt to remove it. We are therefore unable to determine the arrangement of the ridges and grooves of the masticatory surfaces. There are, however, no reasons for believing that the species does not belong to the genus *Testudo*.

The length of the skull, from the snout to the hinder border of the exoccipital near the condyle, is 50 mm. To the occipital condyle the length was from 3 mm. to 5 mm. more. The width, measured over the auditory chambers, is 40 mm. Seen in profile, the upper surface of the skull is convex from the snout to the base of the supraoccipital spine. The interorbital region is 12 mm. wide. The zygomatic arch is 6 mm. wide; the postorbital arch, 5.5 mm. wide. The orbits are nearly circular, the diameters being 15 mm. The nasal opening is 12 mm. wide. The premaxillæ project considerably beyond the anterior border of the prefrontals. The longest diameter of the auditory chamber is 11 mm.; the shortest, 8 mm. The width of the hinder pterygoid region is 12 mm. A prominent, but rather obtuse, ridge occupies the middle of the palate. The sutures between the various bones can not be satisfactorily determined.



FIGS. 536–538.—*Testudo peragrans*. Skull and shell of type.

536. Skull, left side. ×1. 538. Plastron. ×¼.
537. Shell, right side. ×¼. *per.* 1, first peripheral; *hyo*, hyoplastron; *hypo*, hypoplastron; *xiph*, xiphiplastron.

Altho the shell is damaged so that little that is satisfactory can be learned regarding the neural and costal plates and the costal scutes, the general form of the carapace and plastron are well presented. The carapace (fig. 537) is broad, truncated in front, broadly rounded behind, and quite convex. The hinder third is considerably higher than the middle and front portions, and the descent posteriorly and over the inguinal notches is quite abrupt. It is possible that this is due to some extent to distortion during fossilization, but there is no evidence of this. The length of the carapace is 320 mm.; the width, 280 mm. The free borders in front and behind are acute; but the peripherals thicken rapidly from the border, the second reaching a thickness of 20 mm.; the tenth, a thickness of 25 mm.

As stated, the characters of the neurals can not be determined. The costal plates are alternately wider and narrower, the distal end of the fifth being 45 mm. wide, that of the sixth 30 mm. The pygal is convex in all directions, on its hinder, or upper, surface. It is 36 mm. high on the midline, 54 mm. wide above, 28 mm. wide along the free border. Its upper border is excavated to receive the hinder suprapygal.

Little can be learned regarding the epidermal scutes.

Large portions of the plastron (fig. 538) are missing. The anterior lobe is 90 mm. long; 150 mm. wide at the base. The epiplastral lip is very prominent, projecting 30 mm. beyond

the ends of the gulo-humeral sulci. It is truncated in front, with a slight median notch. The median and the gulo-humeral sulci run in deep valleys in the bones. The width of the lip is 66 mm. at the base, and it diminishes slowly toward the tip. On the upper side the lip thickens until it reaches 26 mm. in thickness. This is then suddenly reduced. The gular scutes are 57 mm. long on the midline. The entoplastron is missing. The bridge is 127 mm. wide. The hinder lobe is 148 mm. wide at its base. The hinder end of it is missing.

By its prominent epiplastral lip this species suggests *T. thomsoni* of the Oligocene of South Dakota. However, it is noted that, judging both from the relative sizes of the skulls and of the common parts of the plastra, the lip of *T. peragrans* would be over 100 mm. wide if the animal had attained the size of the type of *T. thomsoni*; whereas the lip of the latter is only 82 mm. wide. The skulls of the two species differ in important particulars. That of *T. peragrans* is much more convex along the midline above, the orbits are more nearly circular, the interorbital space is relatively narrower and the pterygoid region relatively wider.

Testudo vaga sp. nov.

Plate 19, fig. 5; text-figs. 539–547.

In the Cope collection of fossil reptiles belonging to the American Museum of Natural History there are various remains which belong to the species here recognized. These were collected for Professor Cope in 1880, by Mr. J. C. Isaac, from what are probably lower Deep River deposits, in the vicinity of Laramie Peak, Wyoming. These remains belong to at least three individuals.

Fig. 539.—*Testudo vaga*. Plastron. ×¼. No. 1327 A. M. N. H.

The most important of these specimens consists of many fragments of the carapace, the nearly complete plastron, the nearly complete shoulder-girdle, considerable portions of the pelvis, the entire right femur, all of the left femur except the distal end, the proximal ends of the tibia and fibula, nearly all of the cervical vertebræ, and a few of the caudal vertebræ. The catalog number of this individual is 1327.

The plastron (fig. 539) has a length of 381 mm. The length of the anterior lobe is 110 mm.; the width at the base, 195 mm. The front terminates in a lip which closely resembles that of *T. niobrarensis* Leidy, altho it does not project quite so prominently. As in the case of Leidy's species, the hinder portion of this lip, on the upper surface of the plastron, is deeply excavated. The width of the lip from outside to outside of the gular scutes is 80 mm. In the midline there is a notch which is deeper than in *T. niobrarensis*, as shown in Leidy's type. The lip of another specimen, No. 1326, has the lip about as it is in Leidy's figure. The upper surface of the lip slopes upward and backward about 50 mm. to a rounded edge. Beneath this edge is the excavation referred to above. The greatest thickness of the lip is 25 mm. The hyoplastrals are 80 mm. long at the midline; the hypoplastrals, 105 mm.; the xiphiplastrals, 68 mm.

The entoplastron is rhombic, 68 mm. long, 74 mm. wide. The bridge of No. 1327 is 175 mm. wide.

The hinder lobe of the plastron has a length of 86 mm., and a width, at the inguinal notches, of 185 mm. It is notcht behind. At the base the outer face of the hypoplastron rises in a nearly perpendicular wall 28 mm. high. From the inguinal notch the wall diminishes rapidly in height and the outer face comes soon to look upward and outward. The inner face, at the notch, is concave.

The gular scutes have an antero-posterior extent of 60 mm. in the midline, and they encroach on the entoplastron 23 mm. The gulo-humeral sulci are about 28 mm. long on the upper surface of the epiplastra, being thus about one-third of the width of the lip at the base. The humerals meet along the midline 57 mm. The sulcus limiting them behind is somewhat

convex backward. The pectorals occupy 50 mm. of the midline. The sulci bounding them behind are rather strongly convex forward. The abdominals are large, joining along the midline for a distance of 115 mm. The femorals and the anals have about the same fore-and-aft extent, 40 mm.

The fragment of the carapace of the type individual has not been freed from the closely adhering matrix.

In the collection made by Mr. Isaac there is a specimen of a rather small individual, No. 1326, which furnishes a considerable portion of the carapace (plate 19, fig. 5), as well as the characteristic parts of the plastron. All the neurals are represented in whole or part, and in the same way are represented most of the costal plates. The dimensions of the neurals are shown in the table.

Neural.	Length.	Width.
1	31	24
2	22	33
3	20±	23±
4	22	36
5	17	30
6	18	32
7	21	30
8	19	20±

The first neural is broader behind than in front, and there is on its anterior end a prominent boss. The second and fourth neurals are octagonal. The third is represented by only a part; but it was doubtless quadrangular, with the lateral borders convex. The fifth is hexagonal and short. The sixth is hexagonal, with the antero-lateral sides longer than the postero-lateral; while the seventh is hexagonal, with the antero-lateral sides shortest. The eighth is hexagonal and elongated fore and aft.

The costals of this species are strongly modified as regards their width. The third articulated with the second, third, and fourth neurals. It has a proximal width of about 30 mm., while its distal end is only 16 mm. wide. The fourth is very narrow at its proximal end, but it rapidly increases in width, being distally 43 mm. The fifth costal articulates with the fourth, fifth, and sixth neurals; is 28 mm. wide proximally and 15 mm. distally. The sixth is 17 mm. wide proximally and considerably wider at the distal end. The costals are markt on their distal halves with grooves and ridges, produced by the growth of the scutes.

The first vertebral scute had a width of 50 mm. at the anterior end and about 45 mm. at the hinder end. The third has been 66 mm. wide at the middle of its length; the fourth, 53 mm.

Another specimen, brought from the same region by the same collector, had a carapace about 330 mm. long. But little of the plastron is present. The carapace is crusht and various parts are wanting. The number of this individual is 2894. This carapace is peculiar in having the fourth neural hexagonal, instead of octagonal. The sixth costals expand distally, being there 40 mm. and 22 mm. proximally. The seventh costals are narrow, 21 mm. proximally, 14 mm. distally. The ninth peripheral had a thickness of 11 mm. The anterior vertebral scute had a width of 78 mm., while the fifth was 122 mm. wide.

All the vertebræ of the neck of the type specimen (fig. 540) are present except the first and second. On comparison with the corresponding vertebræ of a specimen of *T. radiata* whose plastron is two-thirds as long, it is found that the neck of *T. vaga* was relatively shorter than that of the *T. radiata*, but the centra are in size proportionally broader. There are some differences in the zygapophyses worthy of note. In *T. radiata*, the prezygapophyses of the sixth cervical rise to a height of 10 mm. above the lower border of the centrum, and the zygapophyses measure only 4 mm. each across the articular surface. In *T. vaga* these prezygapophyses rise to a height of 20 mm. and are 11 mm. across. The postzygapophyses of the eighth cervical of *T. radiata* have a length of 7 mm.; those of *T. vaga* a length of 22 mm., a difference out of all proportion to the sizes of the two animals. The cervicals of the latter are in fact as large as those of a *Chelydra* of the same size.

Herewith are furnisht figures of the scapula and the coracoid of the left side (figs. 541, 542). These parts do not differ in any important way from the same bones of *Gopherus polyphemus*, altho they are proportionally stouter. The coracoid is 64 mm. long and 61 mm. broad at the inner end. The neck of the bone is 14 mm. wide.

The vertebral end of the scapula is missing, so that the length can not be stated. Above the glenoid cavity the bone is much comprest. The comprest procoracoid process (fig. 541) has a length of 60 mm., measured from the center of the glenoid cavity.

The humerus (fig. 543) resembles closely that of *Gopherus polyphemus*, altho stouter in build, resembling in this respect that of *T. radiata* of Madagascar. As a portion of each of

the humeri is missing the length of the bone can not be accurately determined, but it must have been close to 95 mm. The head and the radial and the ulnar tuberosities do not differ in any important degree from those of living species of *Testudo*. At the distal end the radial fossa is deeper than in any species of *Testudo* at hand. The radial border is reduced to a sharp edge and this is perforated by the ectepicondylar foramen.

The individual No. 1327 furnishes a nearly complete pelvis (figs. 544, 545), no part being unrepresented except the proximal ends of the ilia and the processes extending backward from the ischia. In general, the pelvis resembles closely that of *G. polyphemus*. Measured from side to side at the upper border of the acetabula, the width was about 120 mm.; from

FIGS. 540–547.—*Testudo vaga*. ×½. No. 1327 A. M. N. H.

540. Fourth to eighth cervical vertebræ.
541. Left scapula, showing glenoid fossa and articulating surface for coracoid.
542. Left coracoid.
543. Right humerus. Probably too great space between parts.
544. Pelvis, seen from below.
545. Pelvis, left side. *il*, ilium; *isch*, ischium; *pub*, pubis.
546. Right femur, dorsal surface.
547. Right femur, tibial border.

the hinder border of the ischium to the front of the pubis the distance is about 58 mm. The ilium had a total length of approximately 70 mm. Its upper end was expanded, and its posterior plate-like process of bone is directed outward. In this respect it resembles the species of *Testudo* at hand.

The ischium measured 50 mm. from the center of the acetabulum to the midline. From the median suture the hinder border runs directly outward until the processes are reacht on which the ischia rest in contact with the plastron. These appear to have had their median edge about 17 mm. from the midline, and to have been about 13 mm. wide. There appears to be much variation among the various species of *Testudo* in respect to the position of these processes. In *G. polyphemus* and *T. radiata* they are placed far outward toward the acetabula; in *T. tabulata*, they are much nearer together.

The angle made by the symphysis of the ischia with the symphysis of the pubis, measured on the upper surfaces of the bones, is very large, about 120°, being greatly like that of *T. radiata*. In *Gopherus polyphemus* it is not much more than 90°. From the point of articu-

following description is taken from No. 1139. All the known specimens were collected in the White River deposits (Oreodon beds), at the head of Horse Tail Creek, in northeastern Colorado.

The members of this species appear to have had a rather narrow and elongated shell; and this was probably considerably elevated. The form was therefore somewhat like that of *Stylemys oregonensis* or that of the living *Testudo tabulata*.

The length of the carapace was close to 460 mm., and the width approximately 300 mm. The anterior part of the carapace which has been preserved (fig. 526) consists of a portion of the left first peripheral, nearly the whole of the nuchal, the first, second, and most of the third, right peripherals, and a part of the first right costal. The anterior border is somewhat concave along the nuchal and part of the first peripheral; then it passes by a broad curve into the side. The free edge of this rim is subacute, but it is considerably roughened. The nuchal is 76 mm. wide along the free border; 126 mm. in maximum width; and about 100 mm. along the median line. Its greatest thickness at the midline is 25 mm. The border of the first peripheral is 77 mm. long; that of the second is 75 mm. The anterior peripherals are but little flared.

The bridge peripherals preserved (fig. 527) are part of the fourth, most of the fifth, sixth, and seventh. Each was about 50 mm. wide and 110 mm. high. A rather deep groove runs along the side of the shell just above the lower ends of these peripherals.

The posterior peripherals (fig. 527) and practically the whole of the pygal (fig. 528) are present. The free edges of all these are acute. The tenth and the eleventh flare slightly. The eighth is 80 mm. high; the eleventh, 63 mm. The thickness of each is about 22 mm. The inferior surface is convex in perpendicular section. The pygal is convex above in all directions. The upper border is 80 mm. wide and somewhat excavated for the second suprapygal; the free border is only about 25 mm. wide. The thickness is 17 mm. The second suprapygal is broadly triangular, with a repand base. The height is 50 mm., the width 80 mm. The penultimate suprapygal (fig. 528) has the usual bifurcate form, with the forks resting on the eleventh peripherals. The hinder portion of the carapace has sloped downward and backward at an angle of about 45°.

The fourth costal had a width of about 60 mm. at its lower end; the fifth, a width of 34 mm.; the sixth, a width of 49 mm.; the seventh, a width of 33 mm.; the eighth, a width of 44 mm. The costals have a thickness of about 8 mm. No neurals have been preserved.

The sulci which limit the dermal scutes of the carapace are usually narrow and only slightly imprest, that passing between the costals and the marginals being broadest and deepest.

The nuchal scute is 36 mm. long and 16 mm. wide. The first marginal is 53 mm. along its anterior border and 81 mm. along the hinder, an unusual form. The second is 77 mm. wide along the free border; 30 mm. along the posterior border. The third has a width of 69 mm. along the free border. The first vertebral had a width of 146 mm. across the anterior end, but narrowed posteriorly. The hinder end of the fifth had a width of about 80 mm. Since most of the median region of the carapace is missing, nothing is to be learned regarding the other vertebrals.

The height of the supracaudal scute (fig. 528, *sc*) is 73 mm.; its width 100 mm. Its upper border rises on the second peripheral about 20 mm.

As already stated, only the anterior half of the plastron of No. 1139 is present. Nor is there at command any plastron which furnishes both the hinder and the anterior portions. It is hence impossible to determine exactly the length of this portion of the shell. The length of the anterior half of No. 1139 (fig. 529, front portion), to the hyohypoplastral suture, is 238 mm. The length of the hinder portion of the type plastron figured by Cope (fig. 529, hinder portion), measuring backward from the hyohypoplastral suture, is 256 mm. This applied to the anterior half of 1139 would bring the hinder border too close to the pygal and therefore must have belonged to a somewhat larger individual than the latter. About 220 mm. may be added to the length of the anterior half of 1139, thus making its plastron 458 mm. long. This implies that the anterior lip must have projected somewhat in front of the anterior border of the carapace, and this conclusion has been reacht on other grounds.

The anterior lobe of No. 1139 has a length of 165 mm. and a width of 214 mm. The free edge is acute, except at the midline, where it is somewhat rounded. The anterior lip does not

project beyond the general border of the lobe. It is truncated in front. The distance between the crossings of the gular sulci over the free border is 110 mm. On the upper side (fig. 530), the lip extends backward 60 mm., thickening until it reaches 36 mm. There is no excavation behind the thickened portion. The suture between the epiplastrals is 65 mm. long. The entoplastron is hexagonal, pointed in front, broad behind. The length along the midline is 108 mm.; its greatest breadth is 104 mm. The hinder lobe may be described from Cope's type. In this individual the hinder lobe was 240 mm. wide and 143 mm. long to the ends of the xiphiplastral apices. The notch in the rear was about 76 mm. wide and 37 mm. deep. In the median portion of this lobe the bone is about 15 mm. thick, but at the inguinal notch the thickness is 42 mm. Here the outer face is almost perpendicular, but it at once begins to slope inward and upward and to diminish in height, so that at the apices of the xiphiplastra the face looks upward and the thickness is only 27 mm. On these apices the face is 56 mm. wide. From the inguinal notch backward this face is separated from the remainder of the bone by a rather sharp ridge. This markt the boundary between the skin and the bone covered with horn. In the case of both the specimens furnishing the posterior lobe there is a sharp notch, about 6 mm. deep, at the very apex of the xiphiplastron.

The gular scutes encroach on the entoplastron. The humero-pectoral sulci pass close behind it. The pectoral scutes are about 20 mm. wide at the midline; the abdominals about 75 mm.; the xiphiplastrals, 50 mm. All of the sulci are narrow, but some are rather deeply imprest.

A portion of another plastron, No. 1147 (fig. 531), consisting of the left hypoplastron and the left xiphiplastron, has a length of 255 mm. The horn-covered surface on the apex of the xiphiplastron is 74 mm. wide.

The elements of the right half of the shoulder-girdle are present. The scapula is about 105 mm. long and 14 mm. wide at the middle of its length. The coracoid is 75 mm. long, and its median border is 60 mm. long. The scapula and the procoracoid process make a little more than a right angle with each other.

There are in the American Museum of Natural History portions of 2 shells from the same region as those described above which are referred with some doubt to the same species. They were considerably larger and had thicker bones. Other specimens still, No. 1146 of the same museum, collected on Old Woman's Creek, Wyoming, in White River deposits, may belong to *T. amphithorax*, but the more characteristic parts are missing. The borders of the hinder lobe are identical in form with those of the type specimen.

Testudo quadrata Cope.

Text-figs. 532, 533.

Testudo quadratus, Cope, Vert. Tert. Form. West, 1884, p. 764, plate lxi, fig. 5.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

This species is based on the lip of a plastron and a portion of a nuchal bone. Notwithstanding the meager nature of these materials, there can be no question regarding the distinctness of the species. The remains were collected by Cope in 1873, in the Oreodon beds of the White River deposits, at the head of Horse Tail Creek, in northeastern Colorado. The individual was evidently a large one. The type specimen is in the American Museum of Natural History and bears the number 1149.

The anterior lip (fig. 532) projected much beyond the general outline of the front lobe. The right and left borders are parallel. The anterior border has crumbled away somewhat, except at a point near the midline; but it was doubtless truncated, with probably a slight notch at the midline. The lateral and probably also the anterior borders were acute. The upper surface is slightly convex, the lower nearly flat. Evidently the lip formed something of an angle with the ascending lower surface of the plastron. The hinder face of the upper part of the lip was not excavated.

What distinguishes this species from all others of our region is the form of the gular scutes. Instead of extending back on the entoplastron, they end at the base of the lip at a sulcus which runs at right angles with the midline. Each scute is therefore about square. The following are dimensions of this lip: Length of lip from gulo-humeral sulcus, 70 mm.; width of lip at base, 120 mm.; thickness at the base, 29 mm.

lation of the pubis with the ischium, near the midline, to the anterior tip of the pubis is 39 mm. The lateral pubic processes are stout, and appear to have been directed less strongly outward than in any of the species of *Testudo* named above. Where it forms the anterior boundary of the ischio-pubic foramen, the pubic bone is beveled off above, being in this respect like that of *Gopherus polyphemus*.

The femur (figs. 546, 547) is strictly like that of *Testudo*, since the greater and the lesser trochanters are united by a high ridge. This converts the fossa which lies between the trochanters of the Emydidæ into a pit. So far as the materials at hand indicate, this pit is much deeper in *T. vaga* than in *Stylemys nebrascensis*. The two trochanters rise to the same level, not quite to that of the head of the femur. On the distal end of the bone, a sharply defined ridge separates the condylar surface for the tibia from that of the fibula, a condition that the writer has not observed in *Testudo*. In *Stylemys nebrascensis* this ridge is still better developt.

The scantiness of the materials from which Leidy's *Testudo niobrarensis* is known makes it difficult to distinguish it with certainty from the species here described. Since the two belong apparently to very different levels the probability is great that they are not identical. The lip of Leidy's species appears to project further beyond the general outline of the anterior lobe and the length of that part of the gulo-humeral scute that lies on the upper side of the epiplastral is shorter than in *T. vaga*, one-fourth the width of the base of the lip instead of one-third. From the younger specimens of *T. osborniana* it differs in the great antero-posterior extent of the pectoral scutes and in the strong differentiation of the costal bones.

Testudo inusitata Hay.

Plate 68, figs. 1, 2.

Testudo inusitata, HAY, Ann. Carnegie Mus., IV, 1906 (1907), p. 18, plates iii, iv.

This name is applied to a specimen which was collected by Mr. Earl Douglass, near Canyon Ferry, Broadwater County, Montana. The horizon is regarded as being that of the Deep River. The specimen is a shell, the right side of which is missing. The catalog number is 311.

The shell is convex above. The outline in front and behind is rounded. The peripherals flare slightly over the limbs. The pygal is missing. The length of the carapace is 265 mm.; the width is 200 mm. The nuchal is 60 mm. long, 47 mm. wide in front, 65 mm. where widest. The first neural seems to have been 4-sided. The second to the sixth are hexagonal. The dimensions are given in the accompanying table.

Dimensions of neurals.			Dimensions of costal bones.			Dimensions of costal scutes.		
No.	Length.	Width.	No.	Proximal width.	Distal width.	No.	Length.	Width.
1	35	26	2	29	38	1	45	71
2	26	35	3	29	18	2	50	75
3	27	37	4	22	34	3	57	78
4	25	37	5	29	20	4	50	70
5	26	37	6	19	33	5	50	75
6	28	36	7	17	17			
7	24	22	8	16	32			

The costal plates are alternately wider and narrower proximally and narrower and wider distally. Their dimensions are shown in the middle table above.

The peripherals over the bridges are high, rising about 65 mm. above the level of the plastron. The free borders of those in front and those behind the bridges are acute.

The vertebral scutes are considerably wider than long. The lateral borders are not greatly angulated. The approximate measurements are shown above in tabular form.

The plastron has a length of 245 mm. The anterior lobe is 80 mm. wide and 135 mm. wide at the base. The epiplastral lip projects 25 mm. beyond the ends of the gulo-humeral

sulci. It is 58 mm. wide at the base and it narrows slightly toward the tip. The latter is truncated. From its acute free borders the lip thickens rapidly, rising on the upper surface until it attains a thickness of 21 mm. The thickening continues backward 37 mm. from the front. The entoplastron is hexagonal, 49 mm. long and 65 mm. wide at the base. The bridge is 105 mm. wide.

The hinder lobe is 53 mm. long on the midline, 65 mm. to the hinder ends of the xiphiplastra. The width at the base is 111 mm. The notch is 43 mm. wide. At the inguinal notch the free border of the hypoplastron is 22 mm. thick, the outer face rising perpendicularly. Further backward the thickness rapidly diminishes, so that the middle of the free border of the xiphiplastron is acute and thin.

The gulars occupy 42 mm. of the midline, barely reaching the entoplastron. The humerals are 55 mm. long, extending slightly behind the entoplastron. The pectorals occupy 15 mm. of the midline. Their outer ends are greatly expanded. The abdominals measure 70 mm. on the midline; the femorals, 25 mm.; the anals, 30 mm.

Much of the outer surface of both carapace and plastron are sculptured strongly by the lines of growth of the epidermal scutes.

This species presents the feature, unusual in *Testudo*, of having only hexagonal neurals. It thus resembles *Stylemys;* but it differs from the known species of the latter in having a prominent epiplastral lip.

Testudo farri sp. nov.

Plate 69, figs. 1, 2; text-figs. 548, 549.

A species of *Testudo* was collected in the Deep River formation, of Smith River Valley, central Montana, in 1891, by a party from Princeton University. This specimen has now the catalog number 10486. Only the shell is represented. This has been considerably crusht downward and a little toward the right side. Of the carapace there are missing all behind the fourth neural and the fifth costals, as well as the first three peripherals of each side. The plastron is complete.

While this species resembles in many respects both *T. niobrarensis* Leidy and *T. vaga* Hay, it is evidently specifically different from both.

An estimate, made on comparison with *Gopherus polyphemus*, indicates that the total length of the carapace (plate 69, fig. 1; text-fig. 548) was originally about 310 mm. The width was not far from the same. The nuchal bone is 55 mm. long and 74 mm. wide. The first, third, and fifth neurals are 4-sided; the second, fourth, and probably the sixth are octagonal. The dimensions of the bones are shown in the table.

Dimensions of neurals.			Dimensions of costal plates.		
No.	Length.	Width.	No.	Proximal width.	Distal width.
1	30	27	2	19	42
2	32	43	3	35	22
3	26	34	4	18	38
4	27	45	5	35	23
5	29	35			

The costal plates are differentiated, as is common in the genus, so that the proximal ends are alternately wider and narrower. The table shows the widths.

The fifth peripheral has a height of 61 mm.

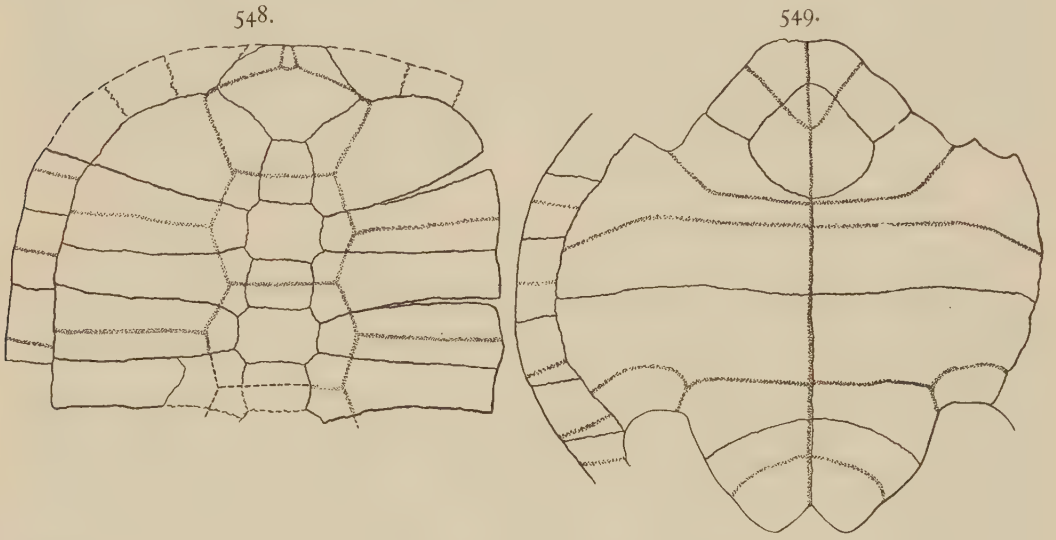
The upper surface of the carapace is strongly imprest by the lines of growth of the epidermal scutes. The sulci are distinct. The boundaries of the vertebrals are straight lines. The nuchal scute is 15 mm. long and 7 mm. wide. The first vertebral is 54 mm. long, 90 mm. wide in front; the second is 56 mm. long, 55 mm. wide in front, 72 mm. wide at the middle of the length; the third is 55 mm. long, and has a maximum width of 76 mm.

The plastron (plate 69, fig. 2; text-fig. 549) is 273 mm. long and 203 mm. wide. The front lobe has a length of 70 mm. and a width of 134 mm. at the base. The lip projects only moderately beyond the curve of the lobe behind the gular sulci. Its anterior border is but little convex and appears not to have been notcht. From one gular sulcus to the other the distance is 62 mm. From the front of the entoplastron to the tip of the lip is 23 mm. Lookt at from above, this lip extends backward a distance of 38 mm., then drops off abruptly to the general level of the upper surface of the lobe. The ledge thus formed is deeply excavated. The thickness of the bone at the hinder end of the lip is 32 mm. The entoplastron

is pyriform, pointed in front, broadly rounded behind. Its length is 60 mm.; its greatest breadth also is 60 mm.

The hyoplastral bones join at the midline for a distance of 49 mm.; the hypoplastrals, a distance of 70 mm.; the xiphiplastrals, a distance of 46 mm. The notch in the rear of the plastron is 38 mm. wide. The hinder lobe has a length of 70 mm., and a width of 140 mm. at the base.

The gulars are, taken together, 58 mm. wide. They overlap on the entoplastron. The humeral scutes are 40 mm. long on the midline; the pectorals, only 12 mm.; the abdominals, 86 mm.; the femorals, 40 mm.; the anals, 25 mm.



FIGS. 548 AND 549.—*Testudo farri*. Carapace and plastron of type. $\times \frac{1}{4}$.

548. Anterior half of carapace. 549. Plastron.

The outer surface of the plastral bones is somewhat sculptured along the lines of growth of the scutes. There were large inguinal scutes and their areas are strongly imprest with the growth lines.

The present species comes from an earlier formation than that to which *T. niobrarensis* is supposed to belong. The latter appears to differ in having a more projecting epiplastral lip. What remains of the entoplastron indicates that this was relatively narrower and longer than that of *T. farri*.

From *T. vaga*, which it resembles, this species is distinguisht by the much shorter union of the pectoral scutes at the midline, 12 mm., instead of 50 mm. There are other differences.

T. osborniana has the union of the pectoral scutes still shorter than has *T. farri*. The entoplastron is of a different shape and the vertebral scutes are less angular.

This species is named in honor of Dr. M. A. Farr, of the department of paleontology in Princeton University, Princeton, New Jersey.

Testudo emiliæ sp. nov.

Plate 70, figs. 1, 2.

The type of this species belongs to the American Museum of Natural History and bears the catalog number 6135. It was found during the summer of 1906, by Mr. Albert Thomson on Porcupine Creek, South Dakota. The beds in which it was found are the Lower Rosebud, a part of the Lower Miocene. The shell only is present and of this the costals of the left side behind the fifth are missing, also the peripherals behind the left seventh, the pygal, the right eleventh peripheral, and the ultimate and penultimate suprapygals.

The length of the carapace (plate 70, fig. 1) was very close to 320 mm. The extreme width is 255 mm. The shell was high and vaulted and apparently highest toward the rear. The out-

line was truncated in front, broadly rounded behind. On the area of the first vertebral scute is a prominent median ridge forming an elongated boss.

The nuchal bone is 73 mm. long, 63 mm. wide in front, 98 mm. where widest. The first neural is 4-sided; all the others are hexagonal, thus resembling those of *T. inusitata*. The accompanying table gives the dimensions of these neurals, of some of the costals, and of the vertebral scutes.

Dimensions of neurals.			Dimensions of costal bones.			Dimensions of vertebral scutes.		
No.	Length.	Width.	No.	Width at neural end.	Width at distal end.	No.	Length.	Greatest width.
1	48	32	2	33	..	1	77	91
2	30	40	3	33	33	2	64	80
3	32	49	4	29	28	3	60	80
4	26	47	5	29	38	4	57	71
5	32	42	6	25	32	5	55±	110±
6	23	43						
7	23	35						
8	15	27						

The costal plates are only slightly differentiated as regards the width of the upper and lower ends.

The sulci are narrow and deeply impressed. The vertebral scutes are wider than long and their sides are not greatly angulated.

The scutal areas of the carapace are more or less strongly grooved by the lines of growth of the scutes. The plastron (plate 70, fig. 2) has a total length of 290 mm., or 273 mm. along the midline, the notch in the rear being 17 mm. deep. The length of the anterior lobe is 95 mm.; its width at the base, 148 mm. From the axillary notches it contracts gradually to the gulo-humeral sulci. The lip is 33 mm. long, 60 mm. wide, with nearly parallel sides. Its anterior border is notcht at the midline and slightly toothed laterally. On the upper surface the thickening of the lip extends backward 44 mm. and the thickness becomes 25 mm. The entoplastron is 51 mm. long and 56 mm. wide. The bridge is 120 mm. long. The hinder lobe is 140 mm. wide at the base and 75 mm. long to the extremities of the xiphiplastra.

The gular scutes are 40 mm. long on the midline; they lack 16 mm. of reaching backward to the entoplastron. The humerals occupy 73 mm. of the midline; the pectorals, 17 mm.; the abdominals, 83 mm.; the femorals, 34 mm.; the anals, 22 mm.

This species resembles closely *T. inusitata* of the Deep River beds of Montana. It differs from that geologically later species in having a longer plastral lip and especially in the failure of the gular scutes to reach the entoplastron. The femoral scutes are relatively wider than those of the Montana species. The type of the latter has but seven neurals; the present species has eight. In *T. inusitata* the widths of the upper and lower ends of the costal plates differ more than in the species here described.

This species is dedicated to my wife, Mary Emily Hay.

Testudo pansa sp. nov.

Plate 71, figs. 1, 2; text-figs. 550, 551.

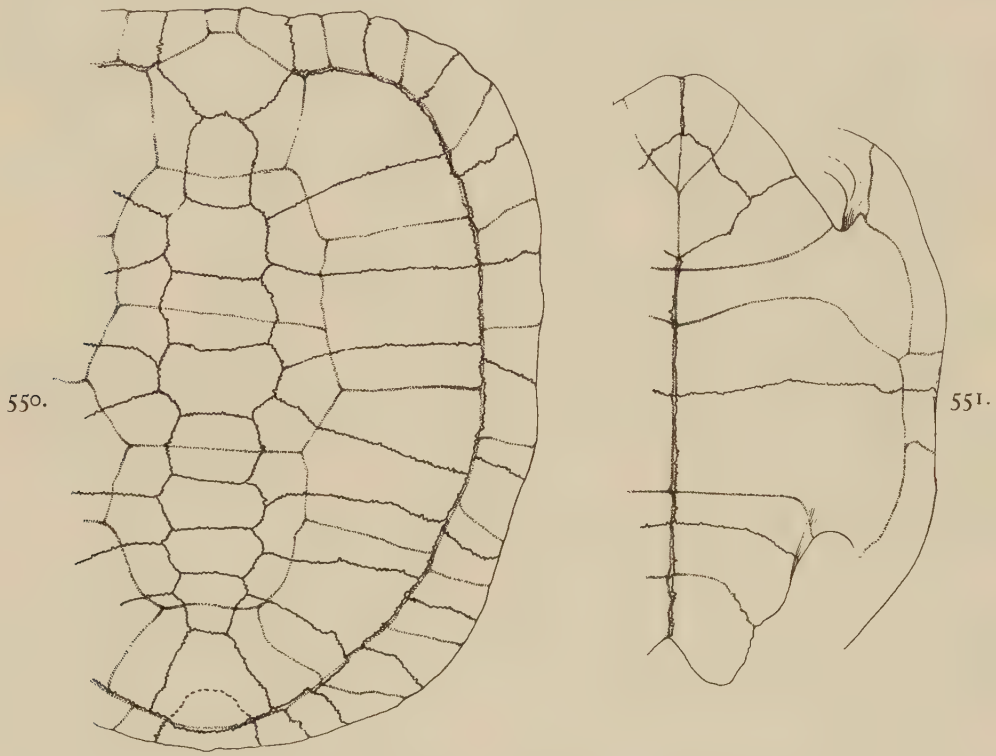
This very distinct and striking species was discovered by Mr. Barnum Brown, of the American Museum of Natural History, in the Pawnee Creek beds of the Miocene of Colorado, in 1901. The exact locality where the type and only specimen was found is near the line between the states of Colorado and Nebraska, north of Sterling, Colorado. The number of the specimen is 5869.

The form of the species is rather peculiar in the genus. It is broad, depressed, somewhat rounded in front, and broadly rounded behind. The plastron is extremely flat. The upper surface of the shell passes abruptly into the lower surface, the free border of the carapace in front passing into a lateral carina on each side, and this again into the free border behind.

The total length of the carapace (plate 71, fig. 1; text-fig. 550) is 775 mm. The greatest width is 690 mm. The elevation of the carapace above the plastron is now only 250 mm., and

it is probable that the shell has suffered little depression during fossilization. The anterior peripherals are slightly flared upward; the hinder peripherals not at all so. The curvature of the upper surface is everywhere gentle. The species possesses unusually narrow peripherals. The first has an extent, at right angles with the free border of the shell, of 65 mm. The sixth rises from the lateral carina 146 mm. The eleventh measures from the free edge, at the suture between it and the tenth, to the costal suture, 87 mm. The inner thickening of the anterior peripherals extends backward from the free border about 57 mm., and the thickness is about 27 mm. The inner thickening of the hinder peripherals continues for about 75 mm. from the free edge, and amounted to about 30 mm. The free edges of the carapace are everywhere acute.

The nuchal bone extends along the border of the shell 118 mm. and backward along the midline 127 mm. The forms of the neural bones may be seen from the figures. Most of them are hexagonal, but the second and fourth are octagonal. The second and fourth costals are narrow at their proximal ends, very broad at the distal. The third and fifth are narrow



FIGS. 550 AND 551.—*Testudo pansa*. Carapace and plastron of type. $\times \frac{1}{8}$.

550. Carapace. 551. Plastron.

distally and broad proximally, where they each come into contact with 3 neurals. The first suprapygal has the usual bifurcate form, and comes into contact on each side with the eleventh peripheral. The second suprapygal is small, extending along the midline 57 mm. The pygal measures 52 mm. on the midline, 110 mm. along the free border.

The plastron (plate 71, fig. 2; text-fig. 551) is very broad and flat. The exact position of the sutures between the plastral bones and the peripherals of the bridge can not be determined, but they are not far, if at all, mesiad of the sulci between the plastral and the marginal scutes. The length of the plastron in the midline is 715 mm.; to the extremities of the apices of the xiphiplastra, 45 mm. more. The width of the plastron is about 580 mm. The anterior lobe has a length of 195 mm., and a width of 400 mm. at the base. The borders of the lobe are acute. The anterior lip is narrow at the tip, very slightly notcht, and 148 mm. wide at the gular sulci. Superiorly the lip thickens backward for a distance of 80 mm. becoming about

55 mm. thick. The posterior lobe is 173 mm. long to the apices of the xiphiplastra, and is 370 mm. wide at the base. The posterior notch is 110 mm. wide and 45 mm. deep. At the inguinal notch the edge of this lobe forms a wall about 55 mm. high, having a rounded outer face and a sloping inner face. Posteriorly the wall diminishes rapidly in height, so that the thickness at the xiphiplastral apices is only 30 mm.

The entoplastron is rhombic in form, 156 mm. long in the midline, 195 mm. wide. The hyoplastra meet along the midline for a distance of 176 mm., the hypoplastrals 156 mm., and the xiphiplastrals 145 mm.

The nuchal scute is about 30 mm. long and wide. The marginal scutes rise to the sutures between the peripherals and the costals. The supracaudal scute seems not to have been divided in the midline. It has a width along the free border of 200 mm. The vertebral scutes are very wide, especially those behind the first. The table gives the dimensions.

Vertebral scute.	Length.	Greatest width.
1	160	160
2	137	215
3	137	260
4	162	200
5	165	227

The gular scutes extend backward on the entoplastron. The humerals have an extent of 100 mm. along the midline. The pectorals are 73 mm. antero-posteriorly at the midline. Beyond this they narrow for some distance, then expand greatly. The abdominal scutes meet along the midline a distance of 207 mm.; the femorals, 100 mm.; the anals, 75 mm.

The pelvis is preserved in position. It has a stout lateral pubic process. The tubera ischii are conical, and their apices are 105 mm. apart.

Testudo osborniana Hay.

Plates 72–75; text-figs. 552–562.

Testudo osborniana, Hay, Ann. N. Y. Acad. Sciences, XVI, 1905, p. 312.

The type of the present species was secured in 1901, by Mr. Barnum Brown, near the line between Colorado and Nebraska, north of Sterling, Colorado. The locality is in the latter state. The deposits affording it belong to the Miocene, and are known as the Pawnee Creek beds. The specimen belongs to the American Museum of Natural History, and bear its catalog number 5868. It consists of a complete shell, the skull (lacking the lower jaw), the pelvis, both hinder limbs nearly complete, and the tail. From the deeply concave plastron it is concluded that the animal was a male. The total length of the carapace is 775 mm.

The skull (figs. 552–554) is rather long and narrow for a *Testudo*, and the bones are moderately thick and heavy. The sides of the skull are parallel from the squamosal processes to the front of the orbits, beyond which they converge with nearly straight outlines to the rounded snout. Seen from the side the upper outline of the skull is concave behind the orbits, above and in front of them moderately convex.

The following are some of the dimensions of the type skull:

	Millimeters.		Millimeters.
Snout to the end of the supraoccipital process	129	Width of interorbital space	26
Snout to occipital condyle	119	Width of nasal opening transversely	26
Width at the base of the quadrates	81	Antero-posterior diameter of the orbit	29
Width at the hinder end of the maxillæ	79		

The height of the skull from the cutting-edge of the maxilla to the upper surface of the frontals is contained in the length from the snout to the condyle 2.8 times.

The prefrontals meet along the midline a distance of 23 mm., and this is also the length of the suture between the frontals. The orbits are subquadrilateral. The long axis, 30 mm., is directed from the prefrontal border backward, outward, and downward. The jugal arch has a width of 16 mm. The maxilla descends from the floor of the orbit a distance of 18 mm. The cutting-edge is concave, especially posteriorly, and is rather coarsely dentated. The squamosal processes are not laterally comprest, but swollen, especially on the inner side; and the outer, upper border rises but little above the upper surface of the paroccipital.

The antero-posterior extent of the otic region, measuring across the paroccipital and prootic, is 33 mm. and contained in the length of the skull to the occipital condyle 3.6 times.

The palatal region (fig. 553) is highly vaulted, the median fossa having a width of 23 mm. The narrowest portion of the pterygoids is also 23 mm. wide. On the outer border of each pterygoid is a distinct ectopterygoid process. The vomer is well archt upward, and is traverst by a longitudinal ridge, which is sharp in front, but rounded behind. The masticatory surface of the maxilla presents 2 longitudinal ridges and 2 deep grooves. The outer and principal ridge is separated from the descending cutting-border of the jaw by the wider groove. This ridge is received in the groove of the mandible. The ridge is sharp, slightly tootht, and runs forward and inward to the premaxilla, then directly forward on the latter bone to its cutting-edge. The inner ridge is low, flat, and rather broad, especially behind. It occupies the inner

552.

553.

FIGS. 552 AND 553.—*Testudo osborniana.* Skull of type. $\times \frac{2}{3}$.

552. Upper surface. 553. Lower surface.

border of the maxilla. There is no ridge occupying the midline along the symphysis of the premaxillæ; hence this species can not be regarded as a *Gopherus*. The masticatory ridges of the right and left sides are separated by a deep longitudinal groove. This is interrupted only by a rough eminence on the hinder ends of the premaxillæ. The cutting-edge of the maxilla descends much below the roof of the mouth.

In many respects this skull resembles that of *T. gilberti;* but, as shown under that species, *T. osborniana* has a much broader jugal arch, a more elongated otic region, a squamosal region less comprest laterally, and a more heavily constructed skull.

The carapace is high and swollen, resembling in general form the shell of *T. radiata*, of Madagascar. The following table presents the dimensions of the carapace and plastron.

	Millimeters.		Millimeters.
Total length of carapace	775	Width of anterior lobe	425
Width of carapace	555	Length of anterior lobe	210
Height of shell	430	Width of posterior lobe	355
Length of plastron	710	Length of posterior lobe	180

The carapace (plate 72; text-figs. 555, 556, 557) is truncated in front, broadly rounded behind. The sides overhang the borders of the plastron. The nuchal and the anterior peripherals are flared upward. The ninth and tenth peripherals are also somewhat flared; the eleventh and the pygal are nearly vertical. The free borders of the carapace, both in front and behind, are acute.

The nuchal bone occupies 140 mm. of the free border and is 182 mm. wide at the widest portion; 141 mm. long in the midline. Its greatest thickness at the midline is 36 mm. The bridge peripherals are very high, about 230 mm. and therefore nearly as high as the costals, the fourth of which is 257 mm. high. The thickness of the inner surface of the hinder peripherals increases to about half of the height and is then suddenly reduced, the maximum being about 23 mm. The pygal is 80 mm. wide at the free border, 114 mm. at the upper border and 83 mm. high in the midline. Its thickness at the midline is 24 mm.

FIG. 554.—*Testudo osborniana*. Skull of type, right side. $\times \frac{2}{3}$.

The second costal is 70 mm. wide near the proximal end, 88 mm. at the distal end. The third is 100 mm. wide at the proximal end, 70 mm. at the distal end. The fourth has a width of 68 mm. at the proximal end, 90 at the distal end. The fifth has the dimensions respectively 83 mm. and 76 mm. The sixth is 73 mm. wide proximally, 102 distally. The seventh is 48 mm. across the proximal end, 93 across the distal. It is seen from these figures that, as in other species of *Testudo*, the costals, omitting the first, are alternately widened and narrowed proximally, whilst alternately narrowed and widened at the distal ends. The degree of differentiation among the costals is, however, less than is usual in the genus.

The neural bones have the dimensions given in the table below.

The first suprapygal is 93 mm. long at the midline, 40 mm. wide at the upper end, and 183 mm. at the lower, the bone having the usual notch in its lower, or hinder, border. The second suprapygal has a median length of 69 mm. and a width of 92 mm.

The vertebral scutes are large, the dimensions being shown in the table.

The nuchal is small, being 27 mm. wide at the anterior end, 11 mm. at the hinder end, and 52 mm. long. The supracaudal scute is 225 mm. from side to side, and has a height of 102 mm.

Dimensions of neurals.			Dimensions of vertebrals.		
No.	Length.	Width.	No.	Length.	Width.
1	112	67	1	163	187
2	73	112	2	150	185
3	70	103	3	133	203
4	79	121	4	165	165
5	57	105	5	185	235
6	61	95			
7	51	85			
8	70	70			

The anterior lip of the plastron (plate 73; text-fig. 556) is greatly developt. At its base, where the sulci bounding the gular scutes cross the free border, the width of the lip is 205 mm. The front of the lip is slightly notcht in the midline. From this the subacute border curves round to the base of the lip. From the free border the bone thickens rapidly backward for a distance of 135 mm. until it reaches a thickness, in the midline, of 75 mm. The thickness then drops suddenly off to that of the greater portion of the plastron. The escarpment of bone thus formed is very slightly excavated. The free border of the anterior lobe behind the lip is acute.

The hinder lobe of the plastron has a wide shallow notch behind. The width of the notch is 130 mm.; its depth is only 23 mm.

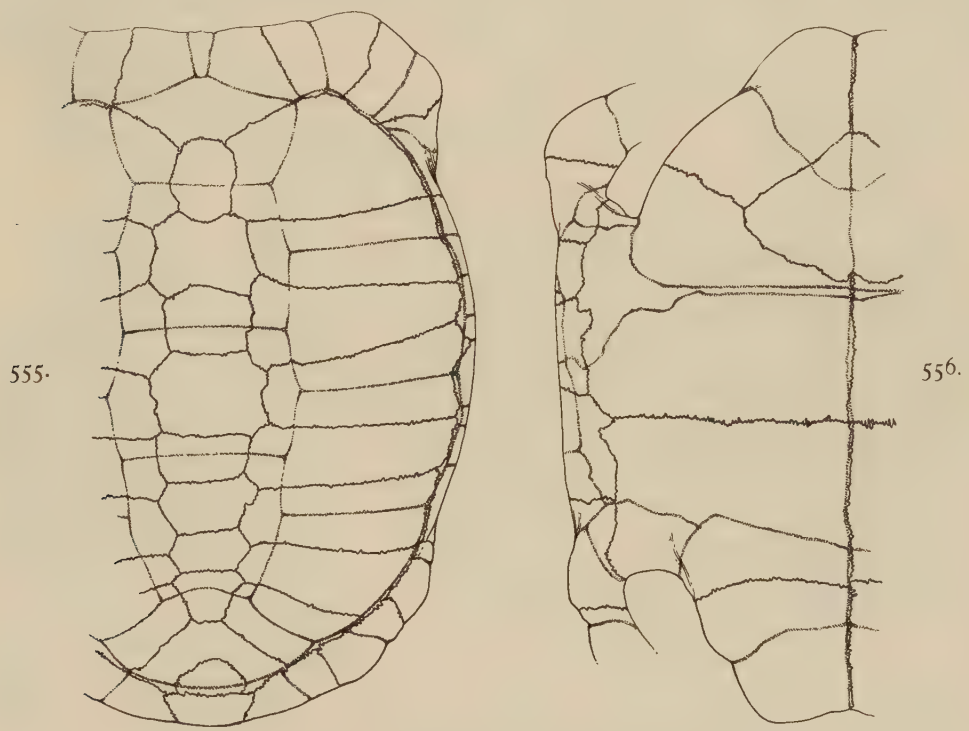
The entoplastron is 153 mm. fore and aft, and 210 mm. wide. The hyoplastra extend 140 mm. along the midline; the hypoplastra, 160 mm.; and the xiphiplastra, 127 mm. The free border of the hinder lobe is subacute. From the border the bone thickens rapidly. Toward the inguinal notch the border rises and forms a wall which reaches a height of 80 mm. Its summit is narrow, and the slope on the mesial side is abrupt.

The gular scutes occupy 170 mm. of the midline; the humerals, 100 mm.; the pectorals only 10 mm.; the abdominals, 255 mm.; the femorals, 76 mm.; and the anals, 85 mm.

The pelvis is in its natural position and is complete, except that the anterior processes of the pubes are missing. The processes on the hinder border of the ischia resemble those of

T. radiata, except that they are relatively thinner, the hinder border is sharp, and they lie in a plane which passes thru the acetabula. The distance between the points of these processes is 130 mm. The upper surface of the ischia, in the midline, is deeply excavated. The process on the under side of each ischium which rests on the plastron is 55 mm. wide, and rather flat below and behind.

The limbs of this tortoise were of the short and heavy type, like those of *T. radiata*, of Madagascar. Fig. 558 shows the left femur seen from the hinder, or ventral, surface. The length is 144 mm. The surface of the bone is strongly imprest for the insertion of muscles. The head is large, its greatest width being 58 mm., and the distance from the uppermost border, when in position, to the lower surface of the ridge joining the trochanters is 73 mm. The notch separating the greater from the lesser trochanter is very shallow, as is likewise the intertrochanteric fossa. The shaft is comprest at the middle of the length, the perpendicular



FIGS. 555 AND 556.—*Testudo osborniana.* Carapace and plastron of type. $\times \frac{1}{8}$.

555. Carapace. 556. Plastron.

diameter, when the femur is in its natural position, being 30 mm., the horizontal diameter 22 mm. The epicondyles are strongly developt. The diameter of the bone through these is 64 mm. The condyles join each other by a strongly developt groove.

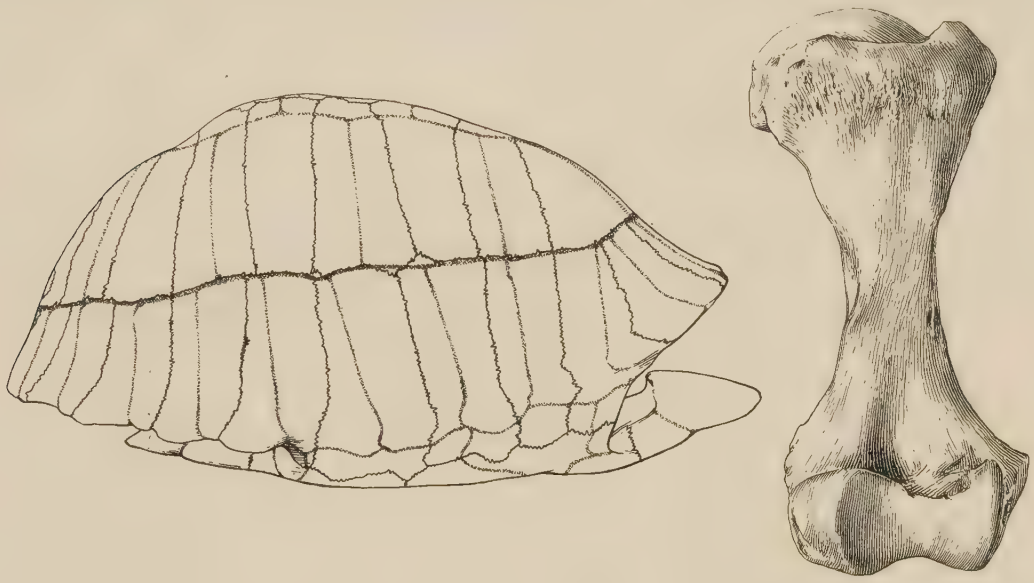
As is to be seen from fig. 559, the tibia (*tib*) is stout. Its length is 100 mm.; the diameter through the tuberosities at the proximal end is 45 mm. The diameter of the shaft between the middle and the distal thirds is 18 mm.

The fibula (fig. 559, *fib*) is 88 mm. long and 20 mm. broad at the proximal end, and 27 mm. at the distal end.

The bones of the tarsus and toes are somewhat disturbed and some are missing. The fibulare (fig. 559) evidently coalesct with the astragalus to form the astragalo-calcaneum. The articular surfaces for the tibia and fibula are strongly concave, and their boundaries are sharply markt. This bone measures from one side to the other 42 mm. Distally there is on the tibial side a long convex articular surface for those tarsals of the second row which support the first, second, and third digits. On the fibular side is a deeply concave surface for the fourth tarsal of the second row.

All the tarsalia of fig. 559 (2, 3, 4, 5, of the second row) are present in the right foot except the first; but this is present in the left foot. The first and the fifth are largest. By its inner border the fifth articulates with the fifth tarsal; and by a part of the lower border, with the fourth metatarsal. The metatarsals of the first and second digits and the first phalangeal of the second digit are missing; but these are present in the left foot. The distal, claw-bearing phalanges are relatively long, that of the first digit being 27 mm. long; that of the second, 35 mm.; that of the third, 40 mm.; and that of the fourth, 37 mm. Each claw phalange is therefore as long as, or longer than, the remaining phalanges, together with the metatarsal of the same digit. In size and form the distal phalanges resemble those of *Gopherus polyphemus*.

The terminal portion of the tail is greatly expanded. This portion is 75 mm. long and appears to consist of 5 vertebræ. The lateral processes of these vertebræ are lengthened, so



557. 558.

FIGS. 557 AND 558.—*Testudo osborniana*. Shell and femur of type.

557. Carapace, side view. ×⅛. 558. Left femur, ventral surface. ×½.

that a broad flat beaver-like paddle is produced. Its greatest breadth is 85 mm. The terminal vertebræ, 10 in number, of *G. polyphemus* have their lateral processes similarly lengthened, but in this case the processes are distinct, true caudal ribs.

This tortoise possest the same kind of supplementary armor that we have found in *T. orthopygia*. The skin of the bottoms of the feet, of the lower leg, of the hinder part of the thigh, the tail, both on the upper and the lower sides, and probably also of the anterior limbs supported an armor composed of bones of various sizes. These bones doubtless lay each beneath a horny scale such as we see protecting the limbs of many of the living species of *Testudo* and of other genera of turtles. Fig. 559 represents the dermal bones, as well as the foot bones of the right hind foot. The dermal bones evidently belonged to the bottom of the foot and the hinder portion of the lower leg. The deeper surface of these bones is seen, as is indicated by the pitting. The external surfaces, where seen, are smooth. In the figure the tarsal bones and the phalanges are lettered. It will be observed that the dermal bones of the foot and the heel are larger than those further up on the leg. How far up on the leg they extended is uncertain.

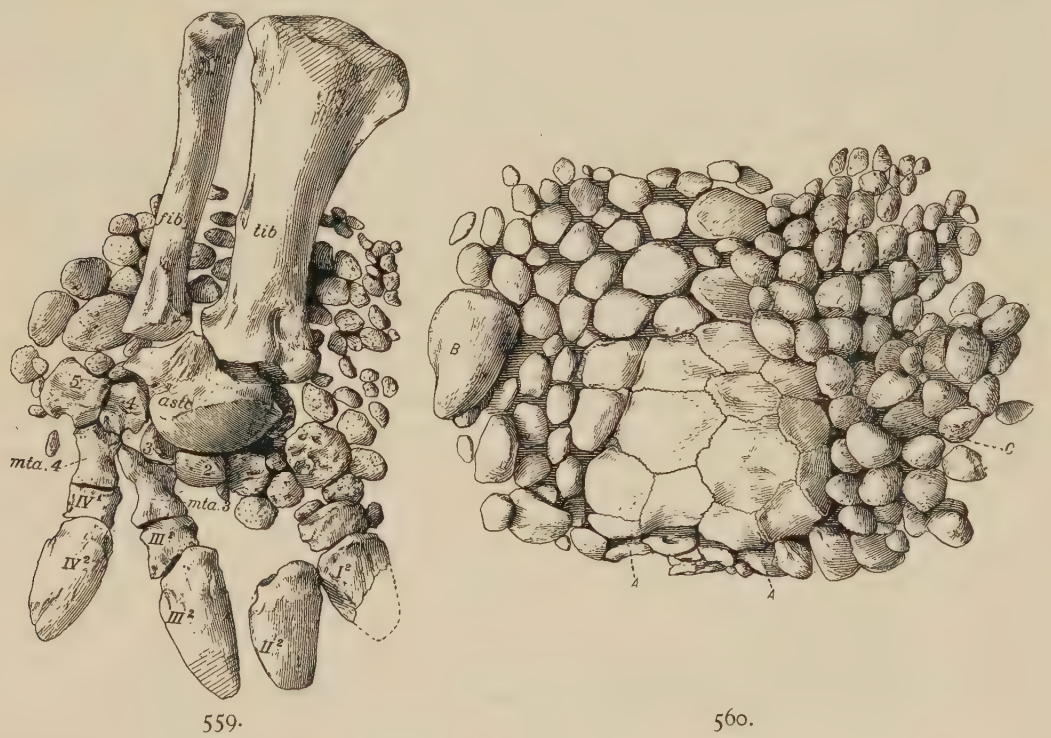
Fig. 560 shows the dermal bones which protected the upper surface of the tail and of the hinder portions of the thigh. In the center of the mass is seen a considerable area consisting of about a dozen bones closely articulated suturally. These overlie the expanded extremity of the tail, of which the last centrum and its processes (fig. 560, *A*, *A*) are seen resting on the hinder border of the carapace. On the left side of the figure the dermal bones adjoining the

tail armor are larger than on the right side, altho they diminish in size outward. All these have a smooth and flat surface, which is undoubtedly the exterior. At the extreme left border (fig. 560, *B*) appears a large pyramidal bone, with an approximately square base. No doubt this represents a spur such as is seen on the hinder side of the thighs of many living species of *Testudo*. The letter *C* of fig. 560 points to the corresponding spur of right side.

On the right side of the figure the bones are seen to be rough and pitted, and the surface is very convex. This is, doubtless, the inner surface, which has become exposed by a flap of the skin of the thigh falling inside out over the skin nearer the tail. The spur of this side is seen below this layer of bones. A portion of the tail nearer its base is present, and this bears on its upper surface a layer of dermal bones in their natural position.

No portions of the anterior limbs are present.

A second specimen (plate 74) of this species was found in the same beds and same locality in 1901 by Dr. F. B. Loomis, of Amherst College. This specimen now bears the number 5870 of the American Museum. At the time of its entombment this specimen was doubtless



559. 560.

FIGS. 559 AND 560.—*Testudo osborniana*. Right hind leg and tail of type. ×½.

559. Right hind leg. *astc*, astragalo-calcaneum; *fib*, fibula; *mta.* 3, *mta.* 4, third and fourth metatarsals; *tib*, tibia; *I*, *II*, *III*, *IV*, the first to fourth digits; 2, 3, 4, 5, tarsal bones of the second row.

560. Armor of bones in the skin around and on the tail. *AA*, extremities of the transverse processes of the last caudal vertebræ; *B*, left lateral spur; *C*, right lateral spur.

uninjured, but thru the weathering of the matrix within a short time before its discovery, the region of the left hind leg was exposed and this limb is now missing, as well as a part of the carapace near it. The terminal phalanges of the left forefoot also are wanting.

It appears probable that this individual perisht while hibernating. The head is withdrawn within the shell, so that the tip of the snout is at a distance of 95 mm. from the anterior border of the carapace. The right foreleg is placed so as to close the shell neatly on that side. The left foreleg is advanct slightly. The right hind leg is withdrawn, so as to shut in its side of the gap between the upper and lower portions of the shell. The broad armored tail filled up the space between the two hinder legs.

The skull, the cervical vertebræ, and some other bones give evidences of having been considerably softened at some time after death.

The length of the carapace of this individual is 930 mm.; the greatest breadth, 690 mm. Thru pressure of the overlying matrix the carapace is somewhat deprest, so that the form of the shell is best shown by the type of the species. The length of the plastron is 840 mm. The anterior lip projects hardly as much as in the type, a smaller individual.

This specimen displays beautifully the armor of the forelegs. A closely compacted layer of bony nodules was imbedded in the skin, from the bases of the claws to the middle third of the upper arm bone. Along the ulnar side of the forearm is a row of larger nodules, one of which appears to have been formed by the co-ossification of two originally distinct bones. Some of the larger nodules appear at the elbow joint. Above this the nodules decrease in size. The palm of the hand was protected by a layer of bones of moderate size. Beyond the bones forming the armor of the foot projected the five claws.

The hind foot possest a sole of bony nodules, but those bones shown in the figure near the claws are the phalanges. Toward the hinder border of the foot the nodules become larger and the two hindermost project as great spurs. Such bony spurs armed with a covering of tough horn would doubtless offer some discouragement to any carnivorous animal that might have sought entrance in that region. Perhaps also these spurs would be of assistance to the animal in walking over a rocky surface. Another great spur lies alongside the fourth claw phalange and simulates a fifth claw. In the type specimen, No. 5868, the fifth tarsal bone of the second row shows an articular surface for a rudimentary metatarsal.

The tail presents in general the same features as that of the type specimen. The central nodules are still more intimately consolidated. The lower border of the armor covering the tail was apparently 140 mm. wide, and was bordered by about 10 nodules, which increase in size from the midline each way. The outer 3 are pointed. It was probably just outside of these that the armor of the tail past into that covering the thighs. In this specimen this armor is continued two-thirds the distance to the knee-joint. On each side of the tail are two very large and pointed spurs, such as we find on the thigh of various living species of *Testudo;* but these in *T. osborniana* appear to have been placed nearer the tail than usual. In the type specimen there appears only one spur on each side of the tail.

The scapula and its proscapular process are slenderer than those of *T. impensa.* The type of the latter has a carapace only a few millimeters shorter than the specimen of *T. osborniana* here described. The table presents the dimensions of certain parts of the two species.

Measurements taken.	*Testudo impensa.*	*Testudo osborniana.*
Diameter of procoracoid process at middle of length:		
Greater	43	31
Smaller	27	23
Length of coracoid from glenoid to median border	155	145
Length of median border of coracoid	145	165
Length of humerus from middle of head to distal end	240	240
Least diameter of shaft	41	38

The ulna is hidden beneath the armor. The right radius is exposed sufficiently to permit determination of the length. This amounts to 135 mm.

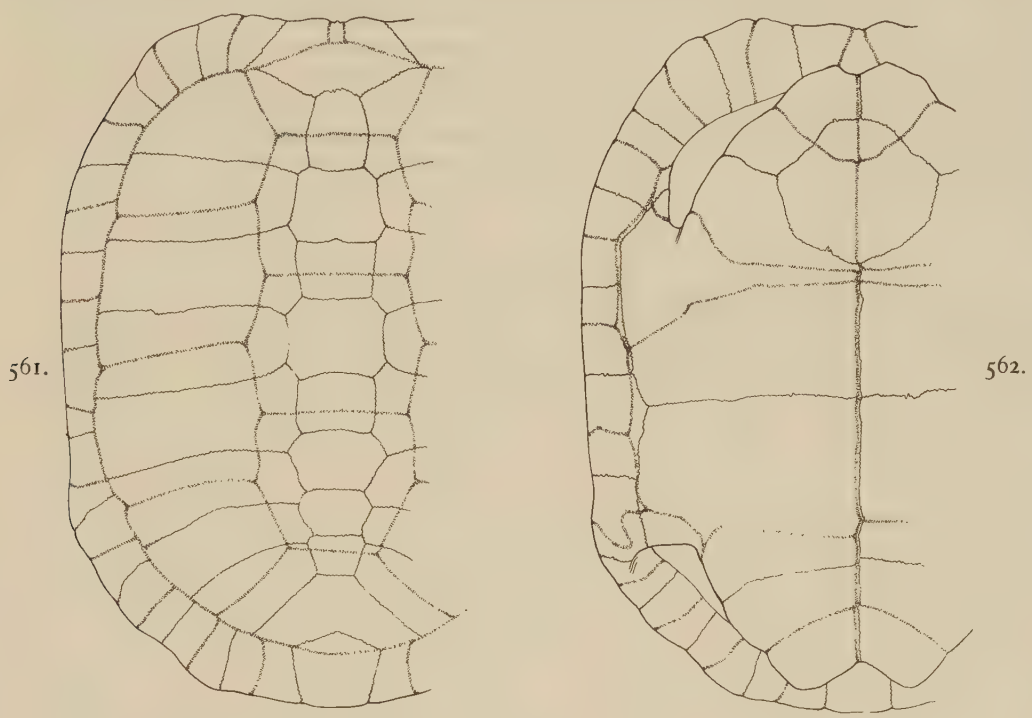
The skull of this individual was considerably macerated about the time of burial; the bones have been more or less fractured and sometimes slightly displaced. One important difference is shown between it and the skull of the type; namely, the interorbital space is much broader. In the type this space is 28 mm. wide; in the one now described it is 43 mm. Ordinarily this difference would be regarded as indicating a distinct species. Here we have probably a difference due to sex. The type is almost certainly a male, as is shown by the very concave plastron. The other individual has a very flat plastron and was probably a female.

The cervical vertebræ are all present. The elements of the first are hidden beneath the supraoccipital process. The second has been damaged so badly that little can be said regarding it, but the posterior end appears to have been concave. The third seems to have had a convex anterior end. Its posterior end is concave. The fourth has the anterior end convex. The contiguous ends of the fourth and fifth are injured, but it seems pretty certain that the hinder end of the fourth was convex and the anterior end of the fifth concave. The sixth is concave in

front, convex behind, with two distinct surfaces, forming a ginglymoid joint. The seventh has both ends concave. The eighth has a ginglymoid concavity in front, and a rounded head behind. The dorsal vertebræ have all been destroyed.

The pelvis of *T. osborniana* appears to have been narrower than that of *T. impensa*, the width of the former, taken across the pubes from the lower border of one acetabulum to that of the other, being 172 mm.; in the latter species, 195 mm.

Besides the large individual described above, Dr. Loomis discovered several others of smaller sizes. One of these, No. 6080, has a carapace 400 mm. long and 335 mm. wide. Another has the carapace 266 mm. long and 218 mm. wide. The shell is complete and only slightly distorted. It is numbered 5871 and is one of five which were piled closely together. Two of these were too much injured to be worth saving. These shells appear to have drifted to their place of burial, for there were no remains of other bones of the skeleton with



561. 562.

FIGS. 561 AND 562.—*Testudo osborniana.* Carapace and plastron of young individual. $\times\frac{1}{3}$. No. 5871 A. M. N. H.

561. Carapace. 562. Plastron.

them. No. 5871 furnishes figs. 1, 2, of plate 75; and text-figs. 561 and 562. In form the younger individuals differ from the adults in being more rounded in front, the angles at the third peripherals not having yet been developt. The peripherals of the bridge region are not so high relatively as in the adults.

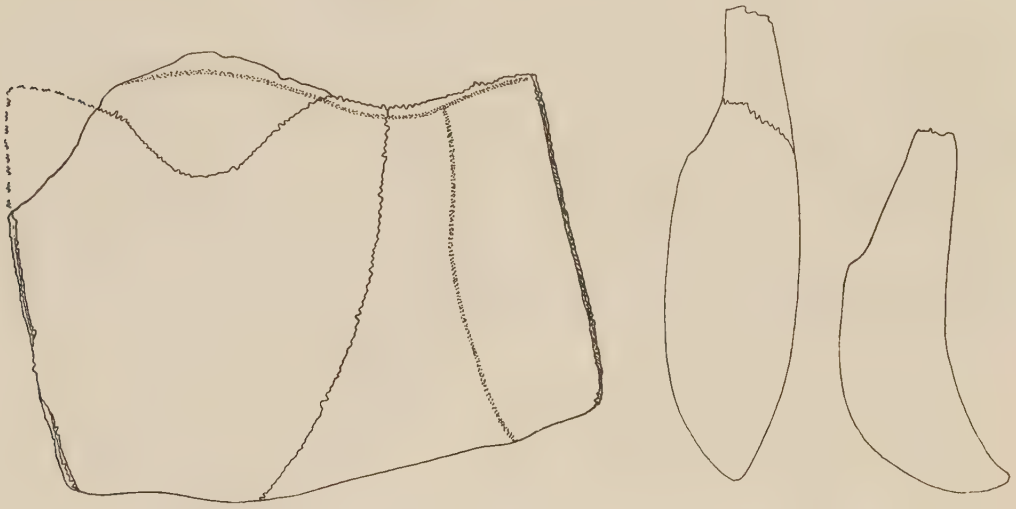
The plastron of No. 5871 (text-fig. 562) has a total length of 253 mm. The anterior lobe is 67 mm. long and 142 mm. wide at the base. The lip is 62 mm. wide at the base and is slightly notcht in front. The upper surface is like that of the larger specimens. The bridges are 125 mm. wide. The posterior lobe of the plastron is 60 mm. long and 130 mm. wide at the base. It is broadly notcht behind.

A still smaller individual found by Dr. Loomis is numbered 5873. It furnisht a shell only slightly damaged and not at all crusht, so that in it we have the form of the young. The shell is high and tumid. The peripherals above the bridge and the distal halves of the costals are ornamented with longitudinal grooves and ridges, which mark the growth of the horny scutes. This, like the other younger individuals, has a low boss on the first neural bone.

This species differs from *T. undata* Cope in that the posterior peripherals do not have a strong recurvature outward and the internal thickening is much below the border joining the costal bones. From *T. klettiana*, based on a pygal bone, it differs in not having the right and left borders parallel, but diverging upward. The upper border is notcht for the second suprapygal. From *T. orthopygia* it differs in having a more elongated skull, a broader plastral lip, and the posterior peripherals less abruptly curved upward near their free border.

The front of the plastron of the younger specimens of this species bears considerable resemblance to the same part of *T. niobrarensis* figured by Dr. Leidy (Cont. Ext. Vert. Fauna West. Terrs., 1873, p. 225, plate iii, fig. 4). It appears however that the lip of Dr. Leidy's specimen projects farther beyond the points where the sulci on each side of the lip cross the border of the plastron, about two-thirds of the lip extending beyond these points. In the specimens of *T. osborniana* at least half of the lip is behind these points, and usually more of it. Only in the type specimen is there half of the lip in front of the line joining the points referred to. In Leidy's species, moreover, the front border of the entoplastron falls behind the ledge formed by the lip; whereas, in *T. osborniana* the front of the entoplastron is slightly in front of the ledge of the lip. Dr. Leidy's species almost certainly belongs to a different geological level.

Of this fine species, which has been named in honor of Prof. Henry F. Osborn, of the American Museum of Natural History, there are, in the museum mentioned, specimens which give us a knowledge of the whole osteology and of various stages of growth.



563. 564. 565.

FIGS. 563–565.—*Testudo arenivaga.* Pygal and eleventh peripheral of type. $\times\frac{1}{2}$.

563. Pygal, eleventh peripheral, and part of suprapygal.
564. Section of pygal and suprapygal along midline.
565. Section of eleventh peripheral at union with tenth.

Testudo arenivaga Hay.

Figs. 563–565.

Testudo arenivaga, HAY, Ann. Carnegie Mus., IV, 1906 (1907), p. 16, figs. 6–8.

The present species is based on a fragmentary individual which belongs to the Carnegie Museum, Pittsburg, Pennsylvania. The catalog number is 1509. The remains were found in 1905, in beds regarded as belonging to the Lower Miocene formation. The locality is about 2 miles north of Agate Springs quarry, in Sioux County, Nebraska. The pygal and the eleventh peripheral are selected for description.

The pygal (figs. 563, 564) has a height, from the free border to sulcus crossing the hindermost suprapygal, of 112 mm. The width at the upper, or anterior, border is 102 mm.; at the free border, 58 mm. The upper border is deeply notcht for the last suprapygal, the distance

from the free border to the notch being only 83 mm. The thickness of the border which articulated with the eleventh peripheral is 30 mm. The exterior surface of the bone is rather strongly convex both from side to side and from above downward. The inferior surface is concave from side to side, convex from above downward. The free border is acute. In fig. 564 the inferior or inner surface is that toward the left hand.

The portion of the posterior suprapygal remaining indicates that the width of this bone was about 60 mm. It is 20 mm. thick.

The eleventh peripheral (figs. 563, 565) is narrow above, widening below. The height is 98 mm.; the width of the upper border, 45 mm.; that of the free border, 87 mm. The exterior surface next the pygal is nearly plane; that near the tenth peripheral strongly concave up and down, the free border here being considerably flared upward. Fig. 565 is a view of the end of the bone which joined the tenth peripheral. The greatest thickness is 31 mm. About 37 mm. below the upper border of the bone the thickness is rather suddenly reduced, forming a shoulder on the inner side of the bone. The upper border is only 13 mm. thick.

It is necessary to compare these bones with the corresponding ones of various other species of *Testudo*.

They resemble most the pygal and the eleventh peripheral of *T. impensa*. The dimensions of the pygal of the latter species are as follows: Height, 145 mm.; width above, 146 mm.; width along the free border, 90 mm. It will be seen that, relatively to the height, the width is greater. The exterior surface, too, is less convex in all directions. The eleventh peripheral of *T. impensa* measures as follows: Height, 122 mm.; width above, 80 mm.; at the free border, 123 mm.

T. osborniana, type, has the pygal 110 mm. high; 113 mm. wide above; 80 mm. wide on free border. It will be observed that the lower border is relatively considerably wider. The outer surface is likewise considerably less convex than that of *T. arenivaga*. The eleventh peripheral of *T. osborniana* has a height of 105 mm.; a width of 66 mm. along the upper border; and a width of 106 mm. along the free border. The two bones have therefore quite different proportions.

The pygal of *T. pansa* is of a different form, being wider below than above, and not so high as wide.

T. undata has the hinder peripherals more strongly flared upward than are those of the present species. According to Cope the pygal, too, is flared upward toward the free edge.

Especially is it to be compared with *T. edæ* of the same beds. The type of the latter is a much smaller individual. The table presents measurements of parts common to the two species.

Measurements taken.	*Testudo edæ.*	*Testudo arenivaga.*
Height of pygal to lower border of suprapygal	45	83
Width of upper border of pygal	70	102
Width of lower border of pygal	43	58
Greatest thickness of pygal	15	30
Height of eleventh peripheral	45	98
Width of upper border of eleventh peripheral	12	45
Width of free border of eleventh peripheral	42	87

It will be observed that the width of the pygal of *T. arenivaga* is less compared with the height than in the case of *T. edæ*. Again, the eleventh peripheral of *T. arenivaga* is considerably broader in comparison with the pygal than is the case with these bones in *T. edæ*. The differences in the proportions of the bones of the two species is well brought out by making plots with the measurements given, those of *T. arenivaga* being divided by 2.

Testudo impensa sp. nov.

Plates 76, 77; text-figs. 566–571.

The dry-land tortoise to which the above name has been given was discovered by Mr. Albert Thomson, of the American Museum of Natural History, in 1902, in the Loup Fork Miocene deposits of Montana, a short distance above the mouth of the Madison River. The locality is in Broadwater County. The number of the specimen is 5867. The parts represented

are the skull complete, the nearly complete shell, both shoulder-girdles, the left humerus, the pelvis complete, 3 injured cervical and 4 caudal vertebræ, and a quantity of dermal bones.

The individuals of this species appear to have reacht a large size, the length of the carapace of the type being 922 mm. Their relationships were close to *T. osborniana*, as shown both in the skull and the shell.

The skull (figs. 566–568) lacks most of one of the posterior lateral angles. There has occurred some crushing and distortion of the prefrontal region. The skull is slightly broader in proportion to its length than in *T. osborniana*. In the latter species the width is 68 per cent. of the length to the occipital condyle, while in *T. impensa* it is 72 per cent. This small difference may disappear on the examination of other specimens. The following are the principal dimensions of the skull:

	Millimeters.		Millimeters.
Total length of the skull	157	Width of palatal fossa	39
Length to occipital condyle	138	Length of the mandible	98
Width at the quadrates	97	Depth of mandible at the symphysis	21
Interorbital space	38		

The prefrontals meet along the midline 21 mm.; the frontals, 27 mm. The orbit is somewhat distorted, but its antero-posterior diameter is 34 mm. The width of the jugal arch appears

FIGS. 566 AND 567.—*Testudo impensa*. Skull of type. $\times \frac{1}{2}$.

566. Upper surface. 567. Palatal surface.

to have been about 16 mm. The maxilla descends below the floor of the orbit 22 mm. The cutting-edge, seen from the side, is convex in front, slightly concave posteriorly, but the concavity seems to have been less than in *T. osborniana*, and the bone did not terminate posteriorly in such a prominent process as in the latter named species. This cutting-edge is irregularly dentated, especially in front. The antero-posterior extent of the otic region, measured across the paroccipital and the prootic, is 31 mm., being contained in the length of the skull to the occipital condyle 4.45 times. The lateral angles of the skull extend behind the occipital condyle about 10 mm. In *T. osborniana* they extend but little beyond the condyle. The portion of the skull in front of the postfrontals equals one-half of the length to the condyle. In *T. osborniana* the portion mentioned equals only 0.45 of the length.

The nasal opening has a width of 30 mm. The prefrontals lack 27 mm. of coming to a perpendicular from the front of premaxillæ. In *T. osborniana* the prefrontals lack only 10 mm. of reaching this perpendicular.

The roof of the mouth (fig. 567) resembles closely that of *T. osborniana*. The outer ridge of the masticatory surface is strongly developt and dentated. Anteriorly it continues forward on the premaxilla of its side; so that between the right and left ridges there is, in the premaxillary region, a deep furrow. The inner ridge of the masticatory surface is broad and rough behind and divided by a deep longitudinal groove. The palate is deeply excavated. On each pterygoid there is a hookt ectopterygoid process. The distance across the two pterygoids is 30 mm.

The lower jaw (figs. 568, 569) is large and heavy. Its length from the symphysis to the angle is 98 mm.; its height at the coronoid process, 32 mm.; at the symphysis, 21 mm. Each ramus has its masticatory surface divided longitudinally by a deep groove. From the outer cutting-edge sharp ridges run down on the outer face of the dentary.

The total length of the shell is 922 mm.; the width, 725 mm. The height can not be exactly determined, on account of injuries to the carapace (plate 76). The middle region of this has been broken in, and the fragments considerably disturbed, while the unbroken portions of the costals and to some extent, the peripherals, have been somewhat deprest. It appears,

568. 569.

FIGS. 568 AND 569.—*Testudo impensa*. Skull and lower jaw of type. $\times \frac{1}{2}$.

568. Skull, right side. 569. Lower jaw, seen from above.

however, improbable that the shell ever had as great height as that of *T. osborniana*. The width of the carapace is 78 per cent. of the length; whereas, in *T. osborniana* the width is 71 per cent. The peripherals have practically the same form as in the last-mentioned species, but those of the bridge regions do not appear to have had relatively as great height. Neither do the peripherals of the posterior region descend so steeply as in *T. osborniana*. In the latter the pygal and the adjoining peripherals slope forward from the perpendicular only about 15° or 20°; whereas, in *T. impensa* the forward slope is about 45°. A part of this angle is due possibly to depression, but this seems improbable. The anterior outline of the carapace is convex, not straight or concave as in *T. osborniana;* and the anterior border does not pass so abruptly into the lateral border.

On account of the crushing in of the upper part of the carapace, it has been difficult to determine the dimensions of the neurals, but the following statements may be relied on. The first neural (fig. 570) is oval in form, and the width has been close to 70 mm. The second is octagonal, and had a width, where greatest, of 120 mm. The third is hexagonal, 73 mm. long and 97 mm. wide. The fourth is octagonal, 76 mm. long, 112 mm. wide. The sixth is hexagonal, 70 mm. long and 100 mm. wide. The seventh is 63 mm. long and 118 mm. wide.

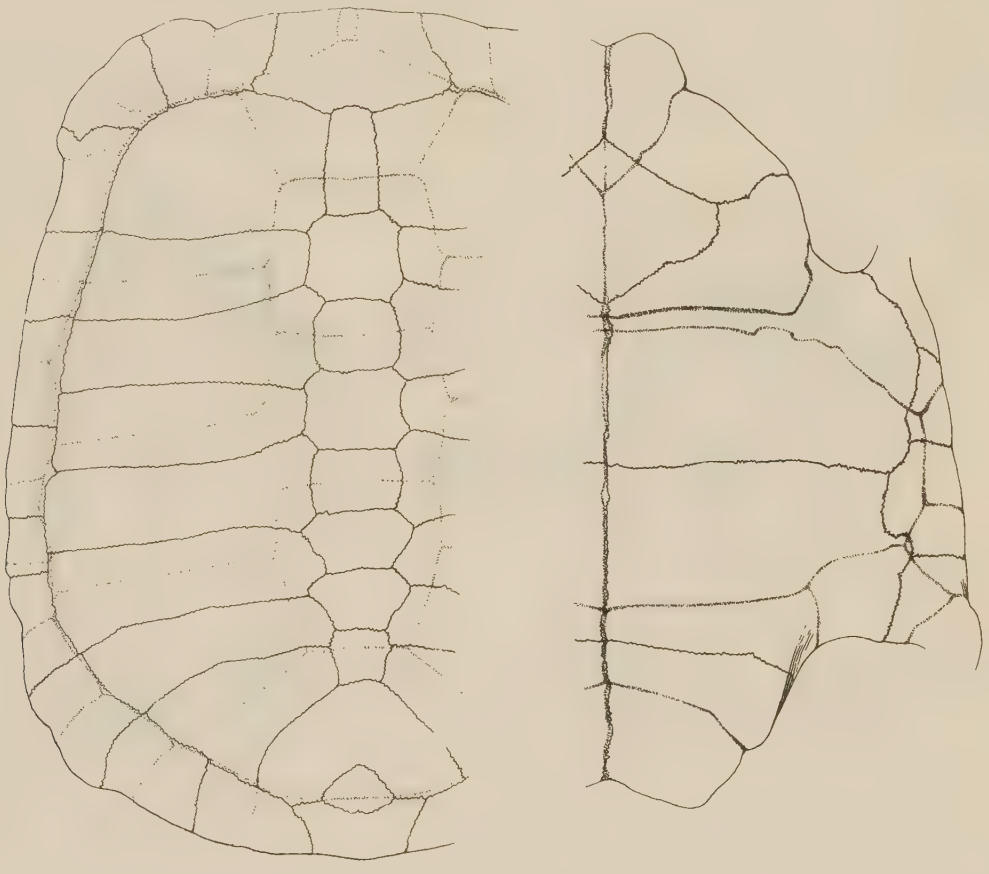
The third and the fifth costals are expanded at their proximal ends and each is in contact with three neurals.

The pygal is 145 mm. wide at its upper end, 114 mm. at the free border. The first suprapygal has the usual bifurcate form and is in extensive contact with the pygal and the eleventh peripherals. The second suprapygal is 90 mm. long and 84 mm. wide.

The plastron (plate 77; text-fig. 571) has a total length of 805 mm. The width, from the outer border of the hyoplastron of one side to that of the other, is 650 mm. There is a considerable concavity in the region between the inguinal notches. The width of the anterior

lobe is 470 mm., its length 230 mm. The anterior lip projects well beyond the crossing of the gular sulci. It does not pass beyond the carapace; whereas, in *T. osborniana* the lip projects beyond the carapace about 80 mm. The lip is 185 mm. wide at its base and nearly as wide in front. It is nearly flat below, convex above, and thickens backward on the upper surface to a thickness of 60 mm. The posterior face of this thickened portion is somewhat excavated. The whole free border of the anterior lobe is acute.

The posterior lobe has a width of 475 mm. and a length of 200 mm. The notch is broad and shallow, its width being 165 mm., its depth only 30 mm. At the inguinal notch the border of the hinder lobe presents a wall 85 mm. high, with a perpendicular outer face and a sloping inner one. The wall diminishes rapidly in height backward, so that the thickness of the apices



570. 571.

FIGS. 570 AND 571.—*Testudo impensa.* Carapace and plastron of type. $\times \frac{1}{8}$.

570. Carapace. 571. Plastron.

of the xiphiplastra is only 34 mm. The structure of this region is greatly like that of *T. osborniana.* The entoplastron is rhombic, 175 mm. on the midline, 230 mm. in transverse extent. The suture between the two hyoplastra is 160 mm. long; that between the hypoplastra, 175 mm.; that between the xiphiplastra, 145 mm.

The first vertebral scute is 250 mm. wide in front. The second is 180 mm. wide; the third is 137 mm. long and 200 mm. wide; the fourth, 166 mm. wide; the fifth, 210 mm. long and 300 mm. wide. The gular scutes lap over on the entoplastron. The humeral scutes join along the midline for 175 mm. The pectoral scutes are very narrow at the midline, only about 15 mm., but their outer ends expand greatly. The abdominal scutes occupy 275 mm. of the midline; the femorals, 75 mm.; the anals, 96 mm.

The scapula is a large and stout bone. Its upper end, for union with the first costal, extended above the glenoid cavity a distance of 162 mm. Near this upper end the bone is 38

mm. thick. At the middle of the glenoid cavity the bone is 54 mm. wide and 40 mm. thick. The procoracoid process extended beyond the middle of the glenoid cavity a distance of 133 mm. The coracoid is short and broad. Each of the borders was about 130 mm. long, measuring the anterior and the posterior from the glenoid cavity.

The humerus has a total length of 250 mm.; the head, a diameter of 58 mm.; the shaft, where narrowest, a diameter of 42 mm. The distance across the condyles is 89 mm. The angle between the radial and ulnar processes is about as in *Gopherus polyphemus*. The trochlear surface is not grooved. There is an ectepicondylar groove, but it does not end in a foramen.

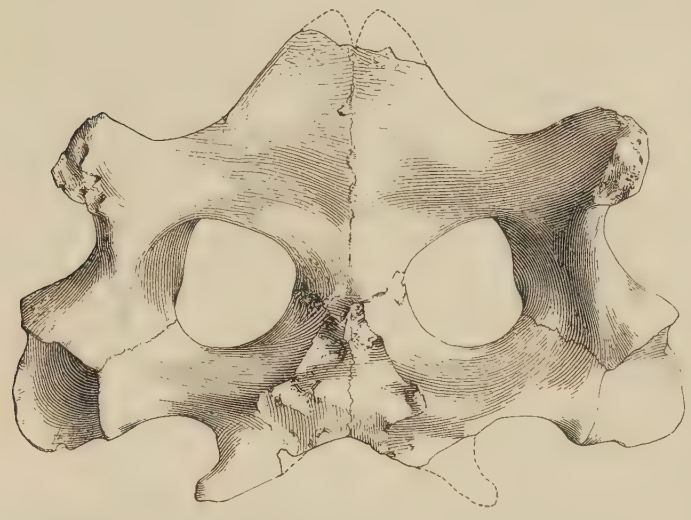


FIG. 572.—*Testudo impensa*. Pelvis of type, $\times\frac{1}{3}$. From below.

The lateral extent of the pelvis, from the lower end of one ilium to that of the other, is 276 mm. The total height is 220 mm. The upper ends of the ilia are damaged. The ischia have the posterior processes rather slender and directed outward and backward. The lateral process of each pubis is short, broad, and rounded on the lower end. The ischiopubic foramen is nearly circular.

Differences among the limb-bones, shoulder and pelvic girdles of this species and of *T. osborniana* are noted in the description of the latter species.

The few cervical vertebræ present offer no novel characters. The caudals have lateral processes which are about 35 mm. long and directed outward and backward. It appears probable that the end of the tail was expanded and supported a shield of dermal bones, as in *T. orthopygia* and *T. osborniana*.

The dermal bones present are of various sizes and forms. The most of them have a base which is roughened and has evidently been buried in the skin. The opposite surface is usually smooth and forms a very deprest cone, the apex of which overhangs the base. This smooth surface was doubtless covered with horn. These bones were probably concealed in the skin of the legs. They vary in diameter from 20 mm. to 25 mm. Two larger, more pointed bones, measuring from base to apex 35 mm. to 40 mm. and having a base of 25 mm. or more diameter, probably formed the cores of spurs on the hinder parts of the thighs. Other bones, flat and broad, with some of the sides straight or nearly so, are suturally united; and these in all probability formed parts of a caudal shield, as in the species referred to above in speaking of the caudal vertebræ.

Testudo undata Cope.

Fig. 573.

Testudo undata, COPE, Ann. Rept. Chief Engineers, 1875, p. 995 (of *separata* p. 74); Wheeler's Rept. on Surv. W. 100th Merid., IV, 1877, p. 283, plate lxvii, figs. 1, 2.—HAY, Amer. Geologist, XXIV, 1899, p. 349; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.

Testudo undata was found in the Loup Fork deposits of the Miocene, in New Mexico, by Professor Cope, in 1874. The species is based on the pygal and 7 hinder peripherals, all somewhat damaged. These specimens are in the U. S. National Museum, with the number 2127. It is believed to be best to reproduce here Cope's description and the most instructive part of his figure 1, of the plate cited (fig. 573).

The specimen which furnishes the characters of the *Testudo undata* includes portions or wholes of 8 marginal bones and 1 costal. The former display a strong recurvature outward, and their internal thickening is near their sutural union with the costals. The borders are acute and do not display any

emargination at either the dermal or osseous sutures. The posterior part of the margin of the posterior marginals is very convex or flared upward, descending at or behind the osseous suture. Thus the free edge has an undulating form. The caudal marginal bone is recurved, not prominent, and with a regular entire free margin. Its lateral sutures expand forward, so that its margin is narrower than its anterior portion. It is not divided by a dermal suture, consistently with its generic character. The surfaces of the bones are nearly smooth. The scutal sutures are wide, and have distinctly-defined borders. The marginal near the bridge is remarkably massive, the bridgeward suture being twice as thick as that joining the free marginal.

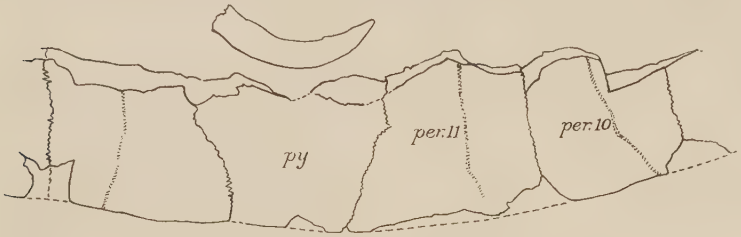


FIG. 573.—*Testudo undata*. Pygal and hinder peripherals of the type. $\times\frac{1}{6}$. Above the pygal is a section of the tenth peripheral.

The size of the *Testudo undata* is as great as that of any of the species of land-tortoises of our Tertiary formations.

MEASUREMENTS.

	Meter.
Length of the free margin of three consecutive posterior marginal bones	0.310
Length of the last marginal bone	.122
Width of the last marginal bone	.135
Thickness at the middle	.017
Thickness of the bridgeward suture of a lateral marginal	.040
Thickness of the opposite suture of the same	.015

Fragments of other specimens, probably of this species, present still larger proportions.

As compared with the two described species of *Stylemys*, this species differs in the strong flaring and recurvature of its marginal bone, and is the more wedge-shaped caudal marginal bone, as well as its much larger size.

To Cope's description may be added the following: The thickness of the anterior sutural border of the eighth peripheral, where it joined the seventh, is 38 mm. The border which joined the ninth peripheral is 22 mm. thick. The eleventh peripheral is 122 mm. along the free border; and was about 70 mm. along the upper border. Its greatest thickness is 23 mm. The intermarginal sulci descend on low broad elevations of the surface and these elevations are more pronounct as the free border of the peripheral is approacht.

Testudo klettiana Cope.

Fig. 574.

Testudo klettiana, COPE, Ann. Rept. Chief Engineers, 1874 (875), p. 995 (of *separata*, p. 75); Wheeler's Rept. on Surv. W. 100th Merid., IV, 1877, p. 285, plate lxvii, fig. 3.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

This species was described from a specimen found by Professor Cope in the Loup Fork Miocene of New Mexico. The type consisted of a pygal bone (fig. 574). This is now in the U. S. National Museum at Washington. Its catalog number is 2126. Cope's description is as follows:

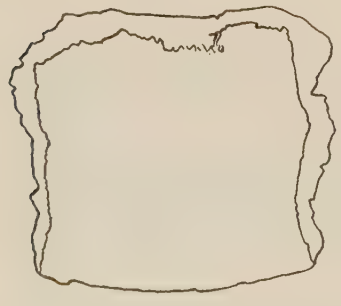


FIG. 574.—*Testudo klettiana*. Pygal forming the type. $\times\frac{1}{3}$.

Indicated especially by a caudal bone of a tortoise of larger size than the one regarded as typical of the *T. undata*. It is, of course, probable that some of the fragments above described without especial reference belong to it. The caudal bone differs from that of *T. undata* in being nearly plane, and thus wanting the recurvature or superior concavity of the corresponding bone of that species. Its form is also quite different. Its lateral sutures are nearly parallel, instead of divergent anteriorly, and slightly concave; if a little expanded proximally, it contracts again to the suture for the pygal bone. The suture is a short squamosal on the outside of the caudal. The thickness of the bone is almost uniform to near the proximal suture; there an abrupt rabbet commences the plane of the thinner pygal.

MEASUREMENTS.

	Meter.
Width, proximal	0.105
Width, distal	.110
Length	.110
Thickness	.109

The free margin is slightly convex.

To this description it may be added that the thickness of most parts of the bone is 20 mm. The free border is acute; most so near the midline.

There is no satisfactory evidence that the bones which furnisht Cope's figs. 4 and 5, of the plate cited in the synonymy, belonged to this species.

The form of the pygal, the lateral borders of which are parallel, appears to distinguish this species from all others of our fossil species of *Testudo*.

Testudo niobrarensis Leidy.

Figs. 575–578.

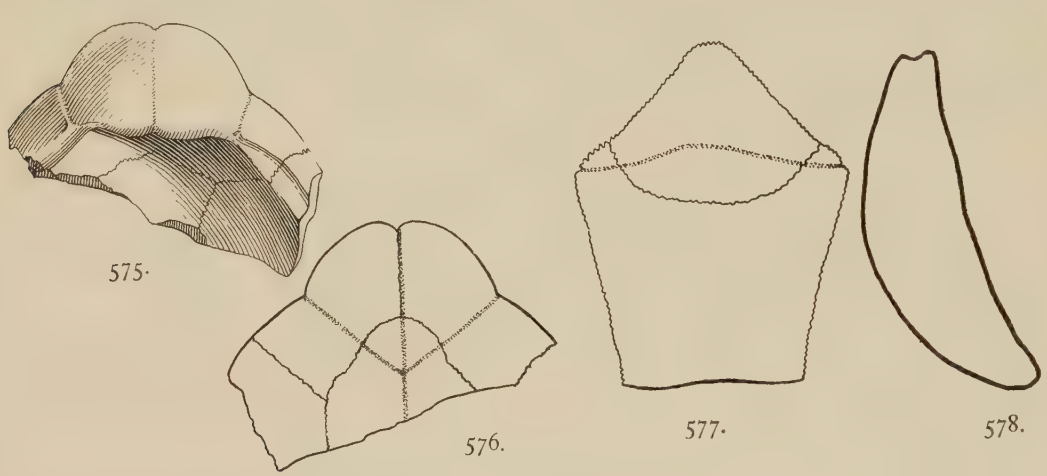
Testudo (Stylemys) niobrarensis, LEIDY, Proc. Acad. Nat. Sci. Phila. 1858, p. 29; Extinct Mamm. Fauna Dak. and Neb., in Jour. Phila. Acad. Nat. Sci. Phila. (2), VII, 1869, p. 26.

Testudo (Stylemys) niobrarensis, HAYDEN, Proc. Acad. Nat. Sci. Phila., 1858, p. 158.

Stylemys niobrarensis, COPE, Ext. Batrach., Reptilia, Aves N. A., 1869, p. 124.—LEIDY, 2d (4th) Ann. Rept. U. S. Geol. Surv. Wyoming, 1871, p. 366; Contrib. Extinct Vert. Fauna West. Terrs., 1873, p. 225, plate iii, figs. 4–6.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 450.

Testudo niobrarensis, LEIDY, Contrib. Extinct Fauna West. Terrs., 1873, p. 340, plate xix, figs. 6, 8.

This species was based on fragmentary bones which were collected by Dr. F. V. Hayden, in the year 1857, in what were regarded as Pliocene sands along the Niobrara River. These



FIGS. 575–578.—*Testudo niobrarensis*. Plastron, pygal, and suprapygal. U. S. N. M.

575. Upper surface of plastron. ×⅔.
576. Lower surface of plastron. ×⅔.
577. Suprapygal and pygal. ×½. Seen from above.
578. Section of pygal and suprapygal. ×½.

deposits are now regarded as belonging to the Loup Fork Miocene. No exact statement regarding the locality is given, but it was in all probability within the state of Nebraska. The specimens are in the U. S. National Museum, at Washington.

The materials described and figured by Leidy consisted of the anterior portion of the plastron, the posterior suprapygal and the pygal, the hinder median portion of the carapace, the distal part of one humerus, and the distal part of one femur. These did not all belong to one individual. The figures of the plastron, the pygal, and suprapygal, being parts most characteristic, are here reproduced. It seems best, considering the possibility that more than a single species is here included, to take as the type of the species the figured epiplastral lip. This is No. 956 of the U. S. National Museum. Leidy's figure of the pygal and suprapygal is two-thirds the size of the original bones, altho he states in the explanation of the plate that it is the size of nature.

In some of his earlier references to this species Leidy was in doubt regarding its distinctness from *Stylemys nebrascensis*, but in his latest description he pointed out one character which definitely separates it from the White River species. This is found in the lip, which projects well beyond the general contour of the plastron and has a deep excavation beneath its backward extension on the upper surface of the lobe.

The plastral lip (figs. 575, 576) is 36 mm. wide, measured from where one gulo-humeral sulcus crosses the free border to the crossing of the other. From a line on the upper side joining these points the rounded, slightly notcht lip extends forward 13 mm. and backward 9 mm. Its hinder border overhangs the excavation. The gulo-humeral sulci on this upper surface are 18 mm. long, that is, about one-third of the width of the base of the lip. The present thickness of the lip is 18 mm. It appears to have been somewhat convex from side to side above.

From the original of Leidy's fig. 6, plate iii, we learn that the fourth vertebral scute was 155 mm. long and 148 mm. wide, and that it occupied a portion of the eighth neural.

The pygal (fig. 577) widens from the free to the superior border. Above, it is somewhat excavated for the reception of the suprapygal. As shown by fig. 578, which represents the perpendicular section thru the pygal and the suprapygal, the pygal was slightly flared outward. The free border is obtuse. The greatest thickness is 13 mm.

The part of the carapace figured by Leidy (No. 93, U. S. N. M.) must have belonged to an individual about 610 mm. long. The part included the sixth, seventh, and eighth neurals, parts of the corresponding costal plates, and the upper end of the bifurcated suprapygal. The fourth vertebral scute had a length of 155 mm. The upper ends of the costals are 15 mm. thick. The limb bones figured by Leidy offer no novel characters.

This species appears to be distinguisht from both *T. vaga* and the younger specimens of *T. osborniana* by the more prominent plastral lip and the shortness of the gulo-humeral sulcus on the upper side of each epiplastron. The pygal appears to differ from that of *T. osborniana* in being obtuse on the free edge. It appears likewise to belong to a more recent formation than either of the species just named. From *T. farri* of the Deep River formation it differs in the more projecting epiplastral lip and more elongated entoplastron.

Testudo orthopygia (Cope).

Plate 19, figs. 6, 7; plates 72–75; 78–80, fig. 1; text-figs. 579–606.

Xerobates orthopygius, Cope, Bull. U. S. Geol. and Geog. Surv. Terrs., iv, 1878, p. 393.
Testudo orthopygia, Hay, Amer. Geologist, xxiv, 1899, p. 349; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.
Xerobates cyclopygius, Cope, Bull. U. S. Geol. and Geog. Surv. Terrs., iv, 1878, 394.
Testudo cyclopygia, Hay, Amer. Geologist, xxiv, 1899, p. 349; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.
Caryoderma snovianum, Cope, Amer. Naturalist, xx, 1886, p. 1044; Amer. Naturalist, xxiii, 1889, p. 662, plate xxxii, figs. 1–17.
Testudo undata?, Williston, Science (2), viii, 1898, p. 132.
Testudo snoviana, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

In the year 1877 a party consisting of Messrs. C. H. Sternberg, R. S. Hill, and W. J. Brous collected from the Loup Fork beds of Decatur County, Kansas, a considerable number of specimens of turtles belonging to the genus *Testudo*. Out of these materials Professor Cope described 2 species, giving them the names referred to him in the synonymy above. These specimens are now in the American Museum of Natural History and have been studied by the present writer, with the result that they are all assigned to one species, which must bear the name *orthopygia*. According to Cope's description, there existed between his two species a great difference, one having the hinder border of the carapace broadly rounded, the other having it nearly straight and with rounded angles behind the inguinal notches. This striking difference, however, disappeared when it was discovered that Cope had mistaken the anterior border of the carapace of the type of his *orthopygia* for the posterior. This being the case, it would be more appropriate to call the species *cyclopygia*, but the other name having preceded the latter in the description, we must, according to rules adopted, retain the name *orthopygia*.

The type of the species *T. orthopygia* bears the museum's number 3929. It consists of the skull and lower jaw; the plastron quite complete; nearly the whole of the anterior free border

of the carapace; peripherals 7, 8, 10, and 11 of the right side; peripheral 11 of the left side; the pygal; fragments of the costals and neurals; the right humerus; the left radius; the left fibula; and the left half of the pelvis. Cope states that the limbs were present, but no other parts of these now remain than those just mentioned. The plastron indicates by its flatness that the individual was a female.

The skull (figs. 579–582) is nearly complete and has been described by Cope. A comparison of the table of measurements here given with those presented by that author shows that some of the latter are incorrect. Cope's figures, when differing, are given in parentheses.

	Millimeters.
Length of skull from snout to end of supraoccipital spine	115
Length of skull from snout to end of occipital condyle	99
Width of skull at quadrates	72 (80)
Width of interorbital space	28 (19)
Greatest width of palatal fossa	32 (36)
Elevation of occiput above basisphenoid	33
Length of mandible from articular to symphysis	75
Depth of mandible at symphysis	18 (19)

The skull is neither elongated nor broad. Seen from above (fig. 579), the outlines expand from the squamosal processes forward to the front of the quadrates. From the hinder ends

579. 580.

FIGS. 579 AND 580.—*Testudo orthopygia.* Skull of type. $\times\frac{2}{3}$.

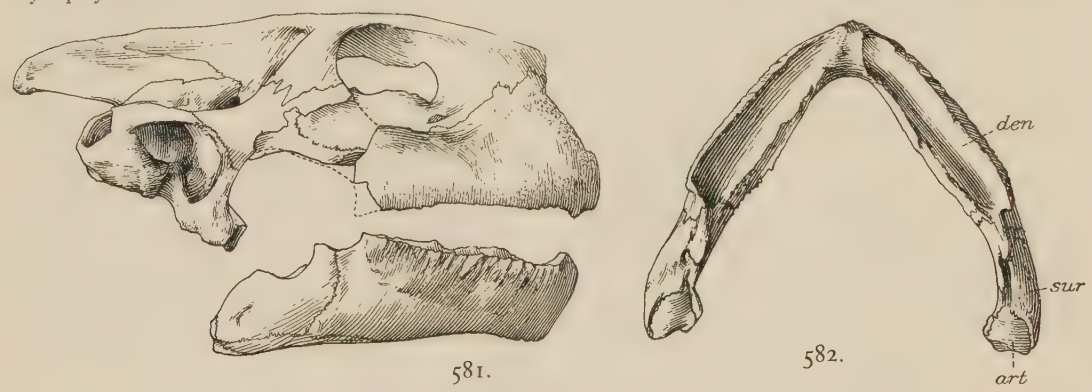
579. Upper surface. 580. Palatal surface.

of the maxillæ the outlines converge rapidly to the snout. The interorbital space is rather wide and flat. The antero-posterior width across the paroccipital and prootic is 20 mm., while that from the prootic to the hinder border of the postfrontal is 25 mm. Both squamosals are missing. On the right side, as shown in fig. 581, the absence of the squamosal has exposed an opening into the tympanic cavity of the quadrate. On the left side a considerable portion of the hinder region of the quadrate has been broken away. The roof of the tympanic cavity does not rise much above the upper surface of the paroccipital, and no prominent ridge ran backward on the squamosal.

The jugal arches are damaged, but they appear to have been narrow; there is evidence that they were at least 11 mm. wide. The orbits are nearly circular, and the antero-posterior diameter is 27 mm. The nasal opening has a transverse width of 21 mm. There is a median notch at the symphysis of the premaxillæ. The cutting-border of the maxilla (fig. 581) is nearly straight, but the hinder end is missing. The palatal fossa (fig. 580) is wide and deeply excavated. Cope states that the width is 36 mm. This seems to be too great, but the limits

are somewhat indefinite. There is no longitudinal ridge along the premaxillary symphysis; hence the species is not a *Gopherus*, as defined by Agassiz under the name *Xerobates*. The outer masticatory ridge is somewhat tootht; the inner ridge is rugose, especially posteriorly. The latter nearly meet on the hinder borders of the premaxillæ. The distance across the pterygoids, where narrowest, is 18 mm. There are distinct ectopterygoid processes. The outward border of each pterygoid is continued backward and outward as a sharp ridge to the hinder part of the base of the quadrate. From the fore part of this base another sharp ridge runs upward and inward mostly on the quadrate. Between the two ridges is found a rather deep groove.

The lower jaw (fig. 582) is complete. The depth varies from 22 mm. at the coronoid process to 18 mm. at the symphysis. The masticatory surface is traverst lengthwise by a deep groove; this does not join that of the opposite side at the symphysis. The external masticatory ridge is sharp and furnisht with small tooth-like processes. From these processes sharp ridges run down on the outside of the jaw. The internal masticatory ridge rises higher than the external. It is rough and dentated. Anteriorly these inner ridges are directed forward one on each side of the symphysis and terminate in a blunt tooth where the outer ridges meet the symphysis.



581. 582.

FIGS. 581 AND 582.—*Testudo orthopygia*. Skull of type, with lower jaw. $\times \frac{2}{3}$.

581. Side view. 582. Lower jaw, upper view. *art*, articular; *den*, dentary; *sur*, surangular.

Several of the dimensions of the plastron of this animal, as given by Cope, differ from those obtained by the present writer. In the following table Cope's measurements are given in parentheses, when differing from the author's:

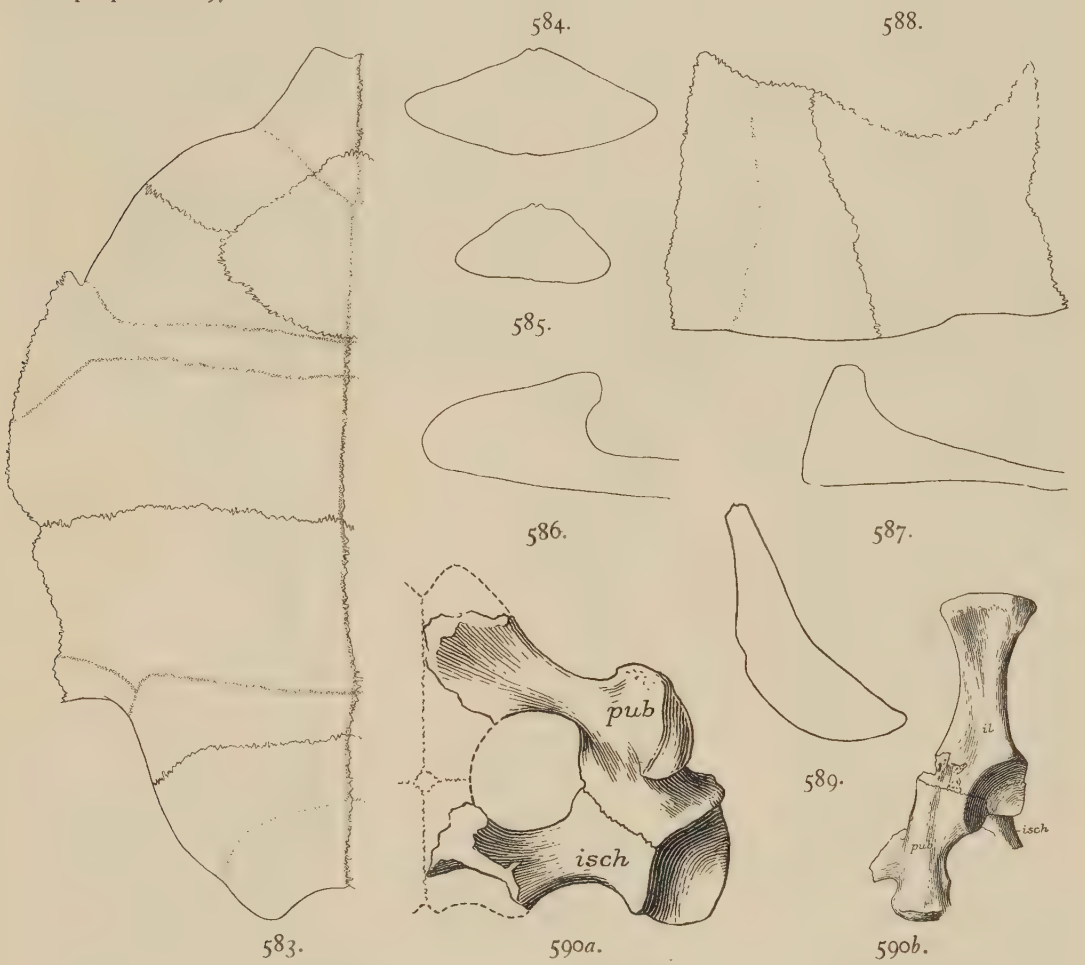
	Millimeters.		Millimeters.
Length of plastron in midline	515 (615)	Width of base of anterior lip	132 (125)
Width of plastron at axilla	330 (360)	Width at end of anterior lip	70
Width at inguinal border	290 (310)	Length of anterior lip above	105 (100)
Distance between posterior apices	100		

Some of these discrepancies may be due to misprints, some perhaps to different methods of taking measurements; but others appear to be obvious errors of determination.

The plastron (plate 78, fig. 1; text-fig. 583) is somewhat upturned at the front; also moderately concave in the middle. Its length, given as 515 mm., is on a straight line from the tip of the anterior lip to the bottom of the posterior notch. The apices of the posterior lobe extend about 24 mm. further backward. The width of the plastron across the middle was close to 450 mm. The greater portion of the free borders of the plastron is much thickened. The figures indicate the form of the anterior lip. The width, 132 mm., is that taken between the points where the sulci forming the outer boundaries of the gular scutes cross the free border. Superiorly the lip runs backward some distance beyond this. Fig. 584 is a section at what is here termed the base; and fig. 585, a section 25 mm. behind the end of the lip. Fig. 586 is a longitudinal section of the lip in the midline. It shows to what extent the lip is excavated posteriorly.

The borders of the anterior lobe from the front to the axillæ are acute. From the border the bone thickens for nearly 50 mm., then thins toward the median portion of the plastron.

At the junction between the epiplastron and the hyoplastron the greatest thickness is 30 mm. The ascending portion of the hyoplastron at the axilla has a considerable groove behind its free border and on the inner surface. Most of the hinder border of the entoplastron is at present missing, but it was evidently broad and rounded behind and pointed in front. The length in the midline was close to 110 mm. The greatest width is 160 mm. The extent of the hyoplastron in the midline is close to 115 mm. The hypoplastra occupy 130 mm. of the midline; the xiphiplastra, 97 mm.



FIGS. 583–590.—*Testudo orthopygia.*

583. Plan of plastron, taken mostly from type. Slightly less than one-fifth the original.
584. Section across the base of the epiplastral lip. ×¼.
585. Section across epiplastral lip, 25 mm. behind tip. ×¼.
586. Longitudinal section of epiplastral lip. ×¼.
587. Section of border of left hypoplastron, just behind inguinal notch.
588. Pygal and left eleventh peripheral of type. ×⅓.
589. Section of eleventh peripheral near union with tenth. ×⅓.
590. Pelvis of type. *a*, lower surface; *b*, left side. ×½. *il*, ilium; *isch*, ischium; *pub*, pubis.

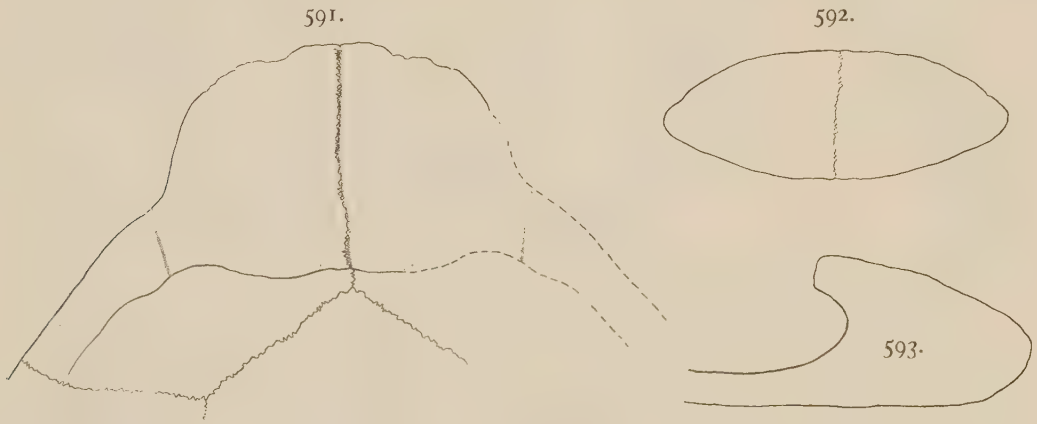
The hinder lobe of the plastron (fig. 583) is short, and is provided with a notch behind, which has a width of 100 mm. and a depth of 24 mm. The lobe is flat below, concave above. At the inguinal notch (fig. 587) there is a wall 67 mm. high, with a perpendicular outer face, a rounded summit 16 mm. thick, and a steeply sloping inner face. Backward, the height of the wall rapidly diminishes, and the outer face soon changes to a slope less and less steep. At the apices of the lobe the height of the wall, above the lower surface of the bone, is only 30 mm. Its width here is 45 mm. The middle portions of the lobe are about 12 mm. thick. The free borders of the lobe in the notch are acute.

The sulci of the plastron (fig. 583) are deeply imprest. The gulars extend backward on the entoplastron. The humerals occupy 85 mm. of the median line; the pectorals only about 18 mm.; the abdominals, 200 mm.; the femorals, 68 mm.; the anals, 68 mm.

As already stated, Professor Cope described the anterior portion of the carapace as the posterior. The evidence that the portion here regarded as the anterior is such is found in the fact that the buttress which ascends from the plastron is on the third peripheral from the median element; whereas, the buttress at the inguinal notch ascends on the fifth peripheral from the hinder median element, the pygal. That Cope had this anterior rim in view is shown by the fact that it corresponds exactly with his description, while the portion of the posterior rim present does not so correspond. All that Cope had to say about any part of the anterior peripherals was a statement of the dimensions of one of them, and these figures apply quite well to the eleventh peripheral.

The carapace was 470 mm. wide, probably rather high and vaulted, abruptly curved in front of the axillary notches, somewhat concave in front, and broadly rounded behind.

The abrupt curves in the front of the shell occur on the second peripherals. The nuchal and the anterior peripherals come to an acute edge. Backward from this edge the bones thicken rapidly, become concave above, especially the second peripherals, and quite convex below. The nuchal bone occupied 105 mm. of the free border and its greatest thickness is 30 mm. At the midline, the border of the carapace apparently lackt 55 mm. of extending as far forward as the tip of the plastron.



FIGS. 591–593.—*Testudo orthopygia.* Epiplastral lip. ×¼. No. 1325 A. M. N. H.

591. Upper surface. 592. Section at ends of gulo-humeral sulci. 593. Longitudinal section.

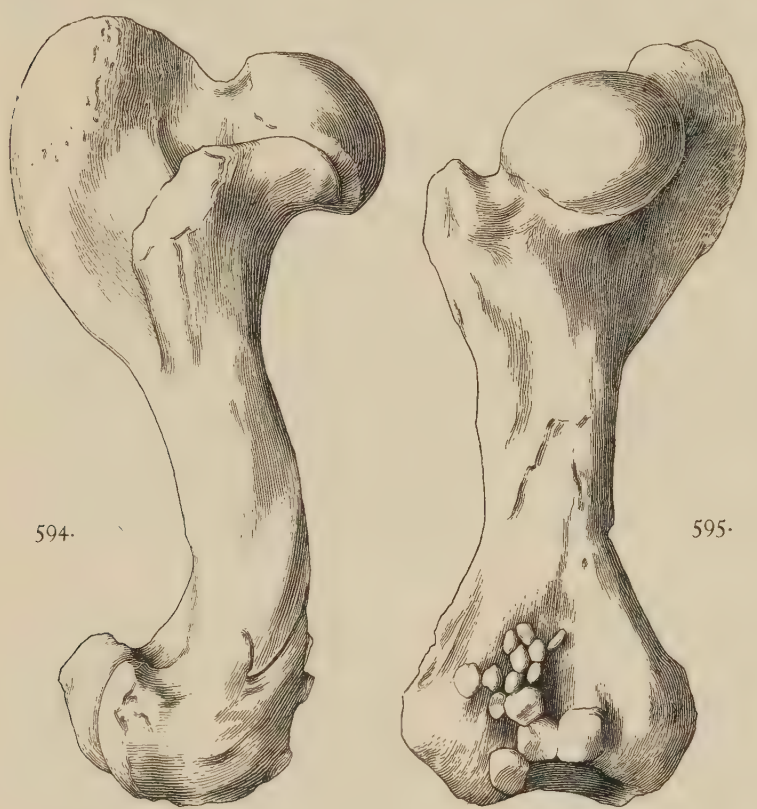
The hinder peripherals flare upward somewhat as the free border is approacht. The eleventh (fig. 588) occupies 80 mm. of the free border, is 34 mm. thick and 107 mm. high. The pygal (figs. 588, 589) is 75 mm. wide at the free border and about 75 mm. high.

Only unimportant fragments of the neurals and costals of the type specimen remain. There was the same alternation of larger and smaller neurals that we see in the living species of the genus. Likewise, the proximal ends of the costals were alternately narrow and wide. Two costals, which are regarded as the third and fourth of the left side, are represented by their proximal ends. The third is 75 mm. wide where it has joined the neurals, while the fourth is only 44 mm. wide. The bone is 8 mm. thick.

There is present with the type a humerus which lacks the distal end. There is no femur present, altho Cope mentions one. He states that its length, estimating for the absent condyles, is 170 mm. and the width of the head plus the great trochanter 90 mm. A perfect femur of a still larger specimen, next to be described, has a length of only 150 mm. The humerus referred to, allowing for the missing distal end, had a length of about 170 mm. and a thickness thru the head and the ulnar tuberosity, of 85 mm. It seems evident, therefore, that Professor Cope inadvertently spoke of the humerus as the femur. As the complete humerus of another specimen will be described, that of the type will be passed by.

The pelvis (figs. 590 *a*, *b*) is represented by the greater portion of the left side. The lateral process of the pubis is rather short, flat, and broad and rounded at the end. The tuber ischii is rather slender and pointed.

No. 1325 of the American Museum is likewise a part of the Cope collection. It was a larger animal than the type just described. The length of the plastron is 615 mm. and its width to the outer borders of the bridge peripherals could not have been less than 555 mm. The width of the carapace at the inguinal notches was 600 mm. Almost the whole of the plastron is present; also considerable parts of the costals and neurals in a fragmentary state; and the greater part of the rim of the carapace, of the shoulder-girdle, of the pelvis, and of the limbs. The plastron differs from that of the type principally in the size and form of the anterior lip. This (fig. 591) is relatively broader, with its sides less converging, less truncate in front, and less carinated above. Since, however, the two individuals are so closely alike in all other respects and there seems to be a good deal of variation in the form of the lip among the various specimens, there is apparently no sufficient reason for regarding No. 1325 as belonging to a different species. The width of the lip at the base is 184 mm. Where the curve of the sides into the anterior border is made the width is 150 mm. Instead of being slightly notcht in front, the anterior border is broadly rounded. From side to side the upper surface is evenly convex. Figs. 592, 593 represent sections of the lip.



FIGS. 594 AND 595.—*Testudo orthopygia*. Left humerus. $\times\frac{1}{2}$. No. 1325 A. M. N. H.

594. Radial border. 595. Dorsal surface.

The entoplastron is 163 mm. long and 200 mm. wide. The humero-pectoral sulcus passes just behind its hinder border. The plastron is rather deeply concave in front of the hinder lobe, a condition which indicates that the individual was a male. Fig. 2 of plate 78 gives a view of the rear of the shell seen from below.

Of the anterior portion of the carapace only peripherals 1, 2, and 3 are present. They differ in no important respect from the corresponding elements of the type. Almost the whole of the posterior rim is present, the pygal and most of the peripherals being complete. At the midline the hinder edge of the carapace falls about 120 mm. behind the plastron. The upper portion of the peripherals is nearly perpendicular, but the lower portion is considerably flared outward. The eighth peripheral has a height of 160 mm.; the eleventh, of 120 mm. The second suprapygal is present, of rhombic form, and about 110 mm. from side to side. Its lower half is placed in a notch in the pygal. The sulcus behind the fifth vertebral scute crosses it horizontally in the middle. Costals and neurals too fragmentary to justify description.

The left scapula is present in No. 1325. The length of the bone from the superior extremity to the middle of the glenoid fossa is 180 mm.; from the latter point to the extremity of the

procoracoid process is 125 mm. The two branches of the bone make an angle of about 120° with each other. The bone is a stout one, the width across it at the glenoid fossa being 50 mm.

The left humerus (figs. 594, 595) is complete, with the exception of a missing part of the ulnar process. It is a stout bone, but not so much curved as in some species of the genus, even less so than in *Gopherus polyphemus*. The total length is 200 mm.; the diameter thru the head and ulnar process is 100 mm.; thru the external and internal condyles, 76 mm.; and thru the narrowest portion of the shaft, 35 mm. The planes of the ulnar and radial tuberosities make a small angle between them, about the same as in *G. polyphemus*. The trochlear surface is well defined. When the bone is in its natural position, this surface is directed strongly downward. It is traverst from the dorsal to the ventral surface by a broad and rather deep groove.

The left radius and ulna are represented in fig. 596, but more or less hidden by portions of the dermal armor. They are stout bones, the ulna having a length of 110 mm., a breadth across the middle of the shaft of 29 mm., across the distal end of 43 mm. The radius has a total length of 112 mm. The head is expanded. The slender portion of the shaft has a diameter of 16 mm.

The bones of the digits are all present, except the ungual phalanx of the first. Some of the bones are slightly disturbed and their positions are somewhat obscured by the dermal bones; but some notes are obtained regarding them. The radiale is a small bone which does not exclude the first carpal from extensive connection with the radius. This radiale has a rhombic superior surface, articulates by its proximal surface with the intermedium, and by its radial surface with the radius. The intermedium is elongated in the direction of the axis of the limb, articulates by its proximal end with the ulna and by its radial surface with the upper portion of the articulatory surface of the radius. The length of the intermedium is 24 mm. The ulnare is not sufficiently enlarged to exclude the fifth carpal from contact with the ulna.

Carpale 1 is rather larger than the radiale, and articulates extensively with the distal end of the radius. The ungual phalanges vary in length from 34 mm. in the first to 38 mm. in the last. They are flat or slightly convex both above and below, and their distal ends are blunt.

In the small size of the radiale and ulnare the bones of this carpus resemble most those of *Gopherus polyphemus*, but in the latter carpale 2 also joins the radius.

Of the pelvis there are present portions of both sides. The ilium has a total length of 155 mm. Its greatest diameter, at the upper border of the acetabulum, is 71 mm. The lateral process of each pubic bone is broad and flat, and the distal end is rounded.

Both femora have been preserved. They too are stout bones, little bent, and having the distal articular surface directed strongly downward, when the bone is in its natural position. That of the right side is shown in figs. 597, 598. The total length, measured parallel with the axis of the bone, is 150 mm. Thru the head and the trochanter the distance is 77 mm.; thru the tuberosities, 63 mm. The shortest diameter of the shaft is 24 mm. A ridge separates the fibular condyle from that for the tibia. The latter has a broad groove running dorso-ventrally.

The tibia (fig. 598) is also a relatively short and thick bone, the length being 99 mm., the distance thru the tuberosities 46 mm.

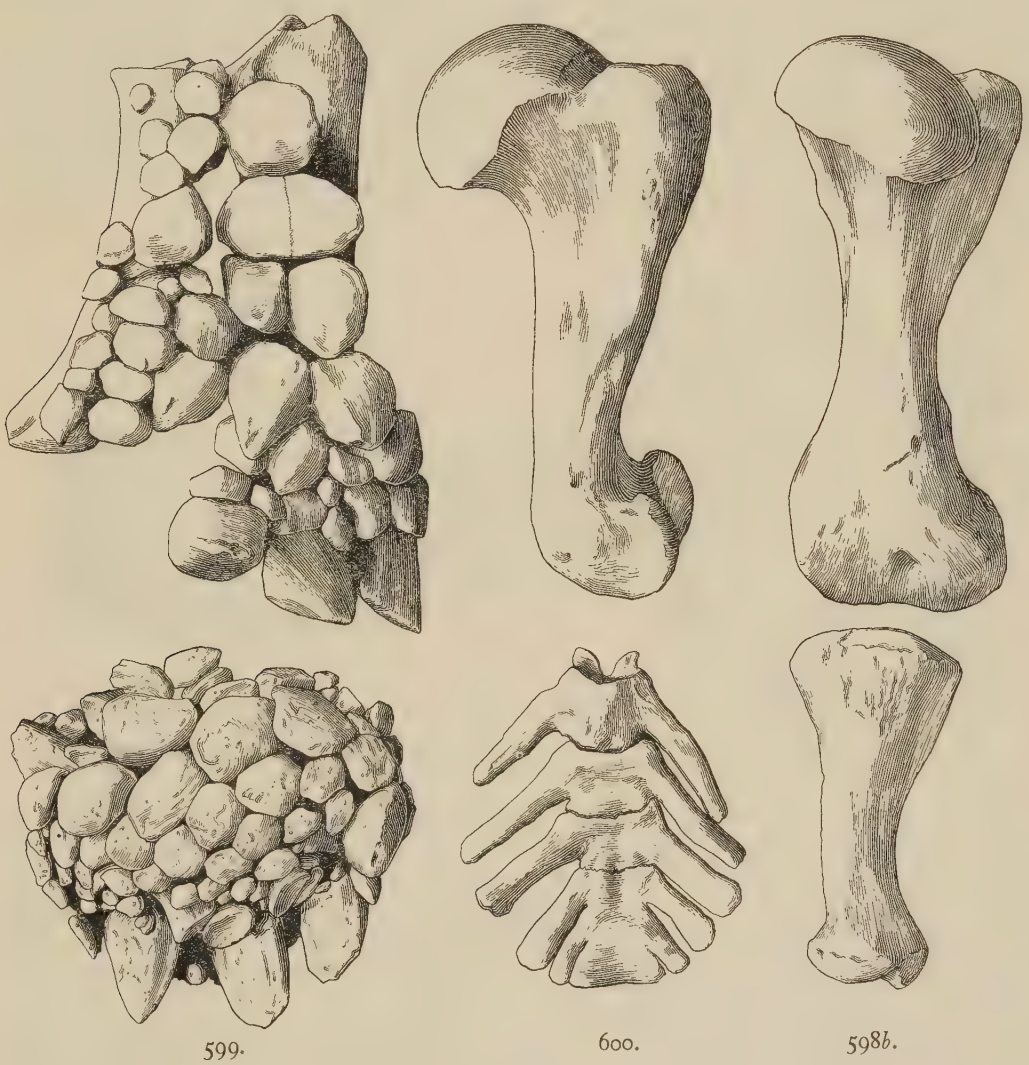
Most of the bones of the left hind foot (fig. 599) are so completely hidden by the dermal armor that, with the exception of the ungual phalanges and calcaneum, they can not be studied. The calcaneum resembles that of other species of *Testudo*. The ungual phalanges, 4 in number, resemble those of the forefoot.

Fig. 600 represents the terminal six vertebræ of the tail. The lateral processes are somewhat elongated, so that the end of the tail is paddle-shaped, instead of pointed. The last three vertebræ are consolidated into one mass. Two or three vertebræ above those shown in fig. 601 have their lateral processes standing at right angles with the centra.

Professor Cope made the observation that this species possest numerous osseous bosses on the limbs, doubtless ossifications of large marginal and other dermal scutes. These are said to have a low apex, central or concentric. Further description was not furnisht. More complete preparation of his specimens, especially No. 1325, shows that these bosses were found on the fore limbs, the hind limbs, and on the tail and the region surrounding the latter. Fig. 595 shows a number of these osseous scutes on the upper surface of the distal end of the humerus. They are rather small and closely joined. No doubt, they lay embedded in the skin that cov-

ered this bone and each was covered with a horny scute. Fig. 596 represents the armor of bony nodules which covered the outside, or dorsal surface, of the lower arm and foot. Here the nodules are large. The one lying across the ulna is really formed of two, suturally joined. In all of these, the outer surface is flat or slightly convex; while the deeper surface is more strongly convex, sometimes forming a low apex. On the forearm and foot the lower end of each scute overlaps the next one below. The same specimen shows that the bottom of the foot was shod with these bony scutes. Close to the toes they are small, but beneath the carpal bones and on the ulna are some very large ones, flat externally, convex on the inner surface.

596. 597. 598*a*.



599. 600. 598*b*.

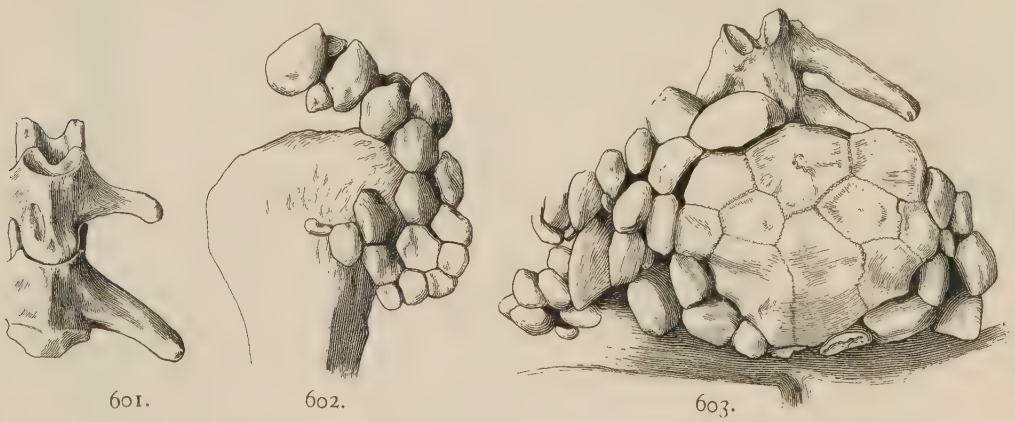
FIGS. 596–600.—*Testudo orthopygia*. Limb bones and tail. $\times\frac{1}{2}$. No. 1325 A. M. N. H.

596. Ulna, radius and front, with dermal ossicles. 597. Femur, tibial border.
598. Right femur (*a*) and tibia (*b*), dorsal view. 599. Sole of hind foot. 600. Tail, lower surface.

Fig. 602 represents the left femur, seen from the ventral side. At the proximal end is seen a patch of nodules which probably occupied the skin just outside of the lateral border of the hinder lobe of the plastron. No specimen shows these nodules on the lower portion of the femur, but we can hardly doubt that they covered also these portions of the limb. Fig. 599 shows the bottom of the hind foot. This is seen to have been heavily armored with these bony plates. Those near the ungual phalanges are smaller; those at the heel, quite large and thin. Others quite small appear to have been found somewhat higher up on the foot.

In fig. 603 we have a view of the dermal armor that covers the end of the tail. This consists principally of about 12 polygonal bones which are suturally joined. Around these are arranged smaller bony scutes which are less closely joined, and which evidently permitted a bending of the skin. The lower border of the fragment here figured rested on the upper surface of the hinder border of the plastron, doubtless just in the position occupied during life. On another fragment (fig. 604), belonging higher up on the tail, there are other ossicles and a conical bony spur. This spur is 38 mm. long, 18 mm. in diameter at the base, and somewhat curved. The coat of mail found on and around the tail resembles that found in *T. osborniana*. Its purpose was evidently to close up effectually the space between the feet when these were withdrawn into the shell.

There can scarcely be a doubt that the dermal bones and the ungual phalanx described as cited in the synonymy, by Professor Cope, under the name *Caryoderma snovianum* and thought by him to belong to a glyptodont, belong in reality to this species. Entirely similar bones are among the specimens of *T. orthopygia* collected for this author and described by him in 1878. Dr. S. W. Williston first made the observation that these supposed Edentate bones were those of a turtle and referred them with doubt to *Testudo undata*. The types of *Caryoderma snovianum* are in the University of Kansas and were found in the Loup Fork deposits of northern Kansas.



601. 602. 603.

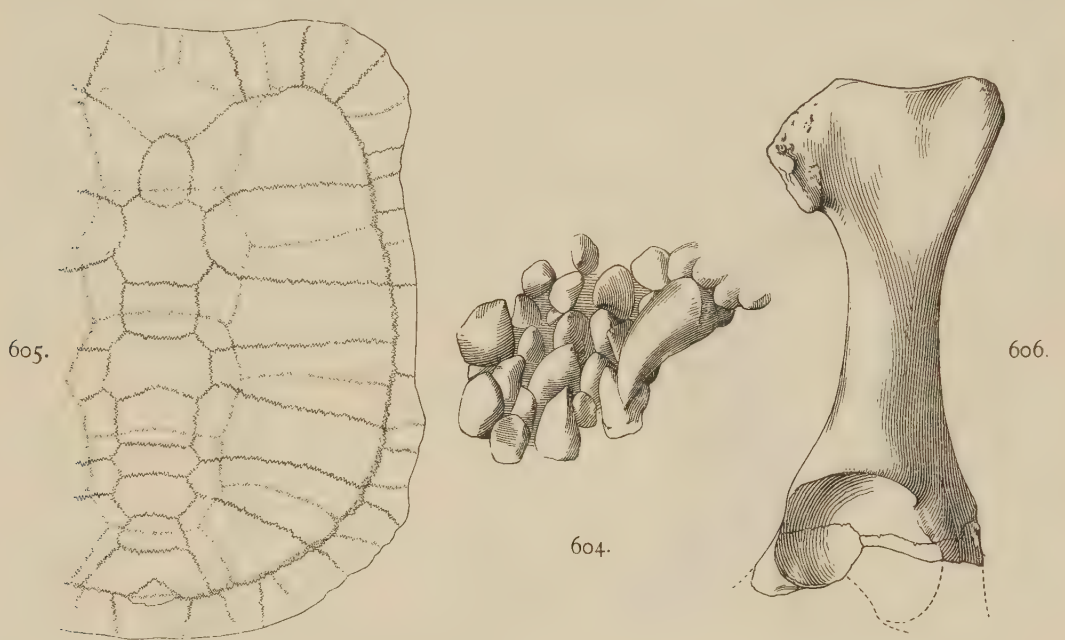
FIGS. 601–603.—*Testudo orthopygia*. Femur and tail. $\times\frac{1}{2}$. No. 1325 A. M. N. H.

601. Two caudal vertebræ, lower side. 602. Proximal end of femur, ventral surface, with dermal bones. 603. Tail, upper surface, covered with an armor of dermal ossicles.

In Cope's description of his *Xerobates cyclopygia* three specimens appear to have been studied. In his table of measurements these are designated as "No. 1," "No. 2," and "No. 3." His "No. 1" is identified by the present writer as No. 1322 (plate 19, fig. 6) of the American Museum of Natural History, since there is no other in the Cope collection that comes so near answering the requirements. The length of the hinder lobe is said to be 140 mm., and the width 240 mm.; but the latter is really 270 mm. With this specimen are many fragments of the carapace. The anterior lobe of the plastron is missing. A portion of the entoplastron is present, but not enough to determine its dimensions. The bottom of the plastron is quite flat, there being only the slightest concavity in front of the hinder lobe. The form of the hinder lobe is that of the type of *T. orthopygia*. The notch in the hinder border has a width of 76 mm. The hyoplastra occupied 112 mm. of the midline; the hypoplastra, 122 mm.; the xiphiplastra, 86 mm. The notch has a depth of 32 mm. The sutures separating the hyoplastra from the xiphiplastra are extremely coarse. The sulcus which runs lengthwise thru the middle of the plastron is very wide and deep. The humero-pectoral and the pectoro-abdominal sulci are likewise deep but narrow. The pectoral scutes are extremely narrow, not more than 4 mm. wide at the midline but widening right and left. The abdominal scutes meet along the midline 190 mm.; the femoral scutes, 57 mm. The femoro-anal sulci are angulated about the middle of their length. The areas occupied by the abdominal scutes are broadly grooved. These grooves indicate the stages of growth of the scutes.

Considerable portions of the carapace of this specimen are preserved; but they are in a fragmentary condition. The costals are crost by conspicuous ridges and grooves.

Cope's "No. 2," No. 1323 of the American Museum, presents an imperfect carapace (plate 19, fig. 7), most of the lateral and all of the hinder border being gone. Cope states that the axial length was 330 mm.; but it is certain that it was in life considerably longer. Cope describes the carapace as being flattened, but this appearance is undoubtedly due to the bad state of the specimen. The front outline is truncate, with the nuchal and peripheral bones flared considerably upward. The sutures between the various neurals and costals are not well shown. The nuchal scute is said by Cope to be 4 mm. long, but this appears to be a misprint for 40 mm. Its width anteriorly is 17 mm.; posteriorly, 24 mm. The second and third marginal scutes are 67 mm. wide fore and aft. The first vertebral scute is 110 mm. wide in front and 77 mm. wide behind. The second and the third are 110 mm. wide across the middle, and this width is about that of the costal scutes. On the hinder portion of the first vertebral scute area is a conspicuous boss, from which a ridge continues forward some distance. On each of the other vertebral



FIGS. 604–606.—*Testudo orthopygia*. Carapace and dermal ossicles. $\times \frac{1}{2}$.

604. Patch of dermal armor near the tail, showing a bony spur.
605. Plan of carapace, constructed from various specimens in A. M. N. H. 606. Ilium.

areas there is a depression, horseshoe-shaped, with the opening forward. The costal bones are grooved and ridged parallel with the borders of the carapace.

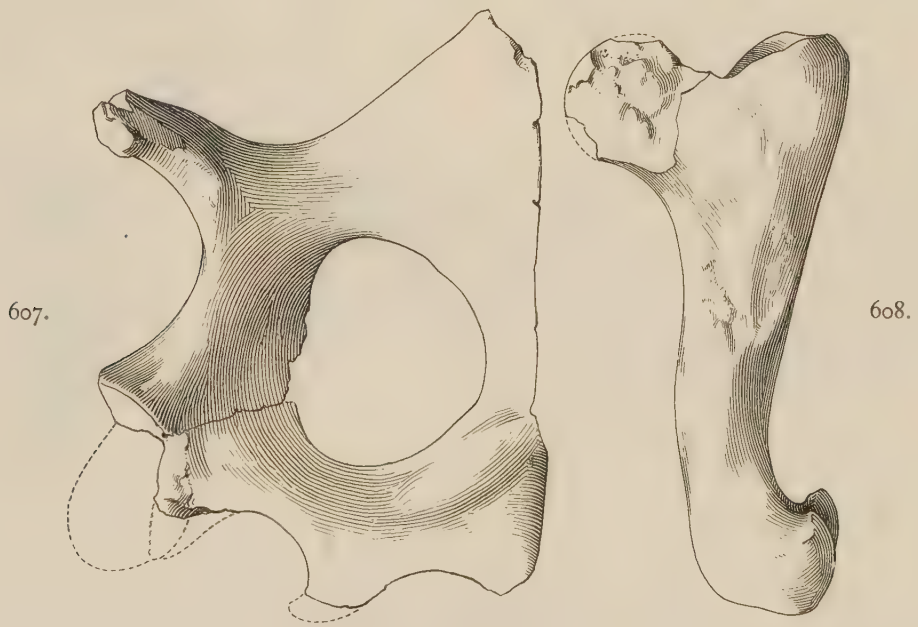
Cope's "No. 3" is evidently the specimen now bearing the American Museum's number 1324, and furnishes the hinder half of the carapace. It is a smaller specimen than the one described above, the width of the carapace at the inguinal notches being only 250 mm. The hinder border is rounded, most of the peripherals are somewhat flared upward at the border, and the free edges are acute. The fifth vertebral scute is 33 mm. wide in front, 100 mm. behind and 62 mm. long in the midline. All of the costal scute areas and that of the fifth vertebral are sculptured with grooves and ridges which run parallel with the border of the carapace.

After a study of all the materials at hand the writer has concluded that the specimens called *cyclopygia* are merely the young and half-grown individuals of *T. orthopygia*. The grooving of the carapace may be observed on some of the costals of specimens that must be referred to *orthopygia*. The width of the pectoral scutes varies in different examples and probably becomes relatively greater in the older individuals. The same remark may be made regarding the notch in the rear of the plastron. The anterior lip of the plastron is likewise variable, but within what limits it is hard to say. The usual form in the larger individuals, some

of which would belong to *cyclopygia*, is that of the type of *T. orthopygia*. In one specimen of "*cyclopygia*," a young individual, there is a broad longitudinal groove running along the under side of the lip, and another on the upper side. This specimen and others of similar size appear to indicate that usually during growth the upper groove disappeared and this surface of the lip became roof-shaped. The lip of No. 1325, which has been described and figured, deviates most from the typical form and under other circumstances might possibly be regarded as belonging to a distinct species.

Fig. 605 is a diagram of the carapace made up from the various specimens in the Cope collection, of fossil reptiles, now in the American Museum of Natural History.

Plate 79, figs. 1, 2 and plate 80, fig. 1, present views of this species seen from above, below, and from the right side. The plastral view is taken almost wholly from No. 2415, A. M. N. H., except the tip of the anterior lip and the border of the carapace in front of the axillary notch. These parts are furnisht by No. 3931, an individual of the same size. The other figures have been taken mostly from No. 2415, but those parts in front of an irregular line extending from the front of the third neural forward and outward to the free border a little in front of the axillary notch are taken from Nos. 3931 and 2320. The tip of the plastral lip is completed from No. 3931. These figures reveal the great height of the peripheral bones.



FIGS. 607 AND 608.—*Testudo sp. indet.* Pelvis and femur. $\times\frac{1}{2}$. No. 2416 A. M. N. H.

607. Pelvis showing slender lateral pubic process. 608. Right femur.

Judging from the numbers of this species in the Cope collection, it must have been very abundant. Another and quite perfect specimen is in the museum of the University of Kansas. Fig. 606 represents an ilium of No. 2426 of the American Museum of Natural History. It is that of the right side.

Plates 81 and 82 are reproduced from photographs of a large specimen of this species which belongs to the American Museum of Natural History. It has the catalog number 6108. This, with several other fine specimens, was collected in the year 1905, by Mr. Charles H. Sternberg, in the typical locality, Decatur County, Kansas. The specimen figured has the shell complete, with the exception of the third, fifth and sixth costal plates. The length from the anterior end of the plastron to the hinder border of the carapace is 710 mm. The plastron projects beyond the anterior border of the carapace 80 mm. The width of the carapace is 520 mm. The height is about 330 mm.

The plastron is 622 mm. long. The epiplastral lip is nearly flat below, roof-shaped above. The thickening on the upper surface continues backward 113 mm. Here the thickness is

about 75 mm. The limbs and the region about the tail present the armor that has been already described. Another shell collected by Mr. Sternberg and now in the American Museum has a total length of 800 mm.

Among the materials collected by Mr. C. H. Sternberg and his party, in 1877, in the Loup Fork beds of Decatur County, Kansas, are some portions of a large tortoise which appears to be specifically different from *T. orthopygia*. The portions represented by determinable bones are the greater portion of the shoulder-girdle, the right half of the pelvis, and the femur. The number of the specimen is 2416 of the American Museum of Natural History.

The length of the coracoid, from the suture in the glenoid fossa to the inner hinder angle, is 135 mm., the breadth of the inner border, 110 mm., and the breadth across the neck of the bone 37 mm. The procoracoid process is a stout bone, without distinctive characters. Only a portion of the scapula remains.

The width of the pelvis (fig. 607), from the pubic border of one acetabulum to that of the other, was 226 mm.; the length along the midline, from the hinder border of the ischia to the notch in the pubes, 135 mm. The least width of the ischium mesiad of the ischial tuberosity is 43 mm.; laterad of the tuberosity, 28 mm. The least width of the pubis mesiad of the lateral process is 32 mm.; posterior to the lateral process, 38 mm. The symphysis of the ischia is very thick, 22 mm.; that of the symphysis of the pubes, only 10 mm. The chief feature which distinguishes the pelvis from that of *T. orthopygia* is found in the lateral process of the pubis. In *T. orthopygia* this is relatively short, but broad and comprest, with the upper surface convex, the lower concave, the distal end broadly rounded, and the horizontal diameter nearly twice the perpendicular. In the pelvis here described the process is nearly twice as long as in *T. orthopygia*, tapering, convex above, with a prominent ridge below, and the horizontal diameter less than the perpendicular.

The right femur (fig. 608) is nearly complete, the head only being somewhat damaged. It is a somewhat slenderer element than the corresponding bone of *T. orthopygia*. The table presents the measurements of this bone compared with those of the femur of *T. orthopygia*, No. 1325, American Museum Natural History.

Species.	Length of femur.	Diameter.		
		Thru trochanters.	Shaft.	Thru tuberosities.
	mm.	*mm.*	*mm.*	*mm.*
Testudo orthopygia.	143	63	24.5	60
Undetermined form.	155+	53	21	64

While the articular head of the femur of the form here described is damaged so that its exact dimensions can not be determined, it appears not to have been so large as that of the species with which it is here compared. On the other hand, the digital fossa is much larger than in *T. orthopygia*, having nearly twice the diameter. It is to be observed that the diameter thru the distal tuberosities of the present form is greater than in the specimen of *T. orthopygia*. The type of the latter species has the distal end of the femur 63 mm. wide.

It is, of course, possible that the materials here described belong to some already named species of *Testudo*, but this can be determined only by future research.

Testudo gilberti Hay.

Plate 80, figs. 2–5.

Xerobates? undata, Gilbert, Kansas Univ. Quart., vii, ser. A, 1898, p. 143, figs. 1–4.
Testudo gilbertii, Hay, Amer. Geologist, xxiv, 1899, p. 349; Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

The only part of this animal yet known is the skull, including the lower jaw. This was found in the Loup Fork deposits of Phillips County, Kansas, and was described by Mr. J. Z. Gilbert, who referred it with some doubt to Cope's New Mexican species, *Xerobates undata*. The latter was based wholly on portions of the carapace, and there is no evidence that the skull belongs to the same species, except that the two occur in the same formation. The skull has suffered some injuries. The squamosal and a part of the quadrate on the left side are gone, thus exposing the tympanic cavity. The pedicels of both quadrates are broken away, as well as the occipital condyle.

The skull (plate 80, fig. 2) is rather narrow. From the front of the tympanic cavity the sides converge slowly to the orbits; then more rapidly to the rounded snout. The height from the cutting-edge of the maxilla to the level of the frontals is contained in the length to the occipital condyle 2.5 times. The following are some of the dimensions:

	Millimeters.		Millimeters.
Snout to occipital condyle	93	Width of interorbital space	24
Snout to end of supraoccipital	110	Antero-posterior diameter of orbit	23
Width at base of quadrates	66	Width of palatine fossa	23
Width at hinder ends of maxillæ	62		

Seen from the side (plate 80, fig. 4) the upper outline of the skull is slightly concave at the parietals and convex over the orbits. From the latter the profile curves gradually downward to the tips of the prefrontals. The nasal opening is wider than high. The prefrontals meet along the midline for 18 mm., nearly the length of the suture between the frontals. The orbits are nearly circular. The jugal arch is narrow, being only 7 mm. wide. The maxillary has a width of 12 mm. from the orbit to the cutting-edge. The latter, seen from the side, is concave from the premaxillary to the hinder end. Any notches or denticles on the premaxillary were small, if existent. The antero-posterior extent of the otic region, measured across the paroccipital and the prootic, is only slightly more than the extent of the temporal opening in front of the prootic. The supraoccipital extends behind the line joining the squamosal processes of the skull a distance of 13 mm.

Seen from below (plate 80, fig. 3) the skull displays a highly vaulted palate. The vomer is highly archt in the middle of its length, and is traverst thruout its length by a median ridge. The masticatory surface presents two prominent ridges separated by a groove. The inner ridge is broad and rough behind. The outer is high and sharp, and somewhat tootht. It is continued forward on the premaxilla, being separated from that of the other side by a very distinct groove. The distance across the pterygoids, where narrowest, is 18 mm. There appear to have been no ectopterygoid processes.

The lower jaw (plate 80, fig. 5) is represented by the co-ossified dentaries. The height is 12 mm. in front, 13 mm. behind. Each dentary presents a masticatory surface having a width of 9 mm. This is occupied by 2 ridges separated by a deep groove. The inner ridge is rough and furnisht anteriorly with small tooth-like processes. The outer ridge has been slightly serrated, and from the serrations low ridges run downward on the outer surface of the bone. The inner and outer ridges meet both in front and behind, thus closing up the groove.

This species resembles closely the one described here as *T. osborniana*, but it differs in several respects. The jugal arch is narrower. The antero-posterior extent of the otic region is about equal to the distance from the prootic to the upper end of the postorbital arch. The squamosal processes are thin from side to side, and rise outwardly to a crest which stands over the tympanic cavity at a level considerably higher than the surface of the paroccipital. The whole skull seems to have been of a lighter construction than that of *T. osborniana*. The skull of *T. orthopygia* is relatively broader, has a considerably wider interorbital region, a squamosal process less comprest laterally and with a less prominent crest above. The orbit is somewhat larger and the snout longer.

Testudo edæ Hay.

Plate 83, figs. 1, 2.

Testudo edæ, HAY, Ann. Carnegie Mus., IV, 1906 (1907), p. 19, plates vii, viii.

The single specimen which forms the type of the present species was collected by Mr. O. A. Peterson, of the Carnegie Museum, in Loup Fork, or Nebraska, deposits, at Running Water, Sioux County, Nebraska. The catalog number is 1535. The specimen consists of a carapace and plastron from which is missing a portion of the right side. Altho there has occurred some crushing together of the carapace and the plastron, it seems evident that even in life the shell was not greatly elevated. The middle region is and was flat from side to side, as far out as the outer borders of the vertebral scutes. Near the hinder border of the first vertebral scute there is a low elongated median boss. At the sides and in front of this the scute area is concave. The second and third vertebral scute areas are likewise slightly concave. Furthermore, the areas of the first, second and third marginal scutes are decidedly concave. The peripherals over the fore and hinder limbs flare upward somewhat. The lower

border of the pygal is drawn in, as in *T. arenivaga*. The length of the carapace is 450 mm.; the breadth was 380 mm.

The first and third neurals are four-sided; the second and fourth are octagonal; the fifth, sixth, and seventh are hexagonal. There appear to be only 7 neurals, of which the table gives the dimensions.

Dimensions of neurals.			Dimensions of costals.			Dimensions of vertebrals.			
No.	Length.	Width.	No.	Proximal width.	Distal width.	No.	Length.	Width in front.	Greatest width.
1	48	45	2	30	85	1	95	115	115
2	43	74	3	54	27	2	83	83	120
3	37	58	4	28	70	3	93	100	130
4	56	72	5	48	31	4	75	90	105
5	40	65	6	32	63	5	93	55	140
6	36	60							
7	40	40							

The nuchal is 92 mm. long, with a maximum width of 105 mm. and a frontal width of 73 mm. All the peripherals are acute on the free border, and each presents a projecting point at the end of the intermarginal sulcus.

The costals are strongly differentiated as regards the widths of the opposite ends. The table presents their widths.

Some measurements of the pygal and the eleventh peripheral are given under the description of *T. arenivaga*.

The sulci are all narrow and they run along on the summits of low ridges. The dimensions of the vertebral scutes are shown above.

The plastron has a total length of 445 mm. It is concave especially in the hinder third, a condition that indicates that the individual was a male. The anterior lobe is 155 mm. long and 205 mm. wide at the base. This width continues forward with hardly any diminution to a point in front of the hyoepiplastral suture. The border then rounds rapidly to the base of the epiplastral lip. The width of the latter, at the ends of the gulo-humeral sulci, is 90 mm. The lip extends forward from its base a distance of 55 mm., narrowing rather rapidly. The extremity is slightly damaged, so that its exact form can not be determined. The lower surface of the lip curves upward strongly, like the runner of a sled. The upper surface is slightly convex from side to side. The greatest thickness of the lip is about 25 mm. On the upper side the thickening extends backward from the front of the lip a distance of 105 mm., thus including the front end of the entoplastron.

The length of the entoplastron is 84 mm.; the width, 88 mm. The bridge is 185 mm. wide.

The hinder lobe is 112 mm. long and 235 mm. wide at the base. The posterior notch is 33 mm. deep and 70 mm. wide. At the inguinal notch the thickness of the hypoplastron is 30 mm. This becomes rapidly reduced farther backward.

The gulars overlap the entoplastron about 22 mm. The humerals occupy 80 mm. of the midline; the pectorals, only 25 mm.; the abdominals, 120 mm.; the femorals, 60 mm.; the anals, about 40 mm.

This species is named in honor of Mrs. Eda Peterson, wife of the discoverer of the type specimen.

Testudo hollandi Hay.

Plate 84, figs. 1, 2.

Testudo hollandi, Hay, Ann. Carnegie Mus., IV, 1906 (1907), p. 18, plates v, vi.

The type of this species belongs to Carnegie Museum, Pittsburg, and has the catalog number 1561. It was discovered in the upper beds of the Loup Fork, or Nebraska beds, near Running Water, Sioux County, Nebraska, by Mr. O. A. Peterson. The shell alone is preserved and this is somewhat crusht downward. The carapace is broad, truncated in front, rounded behind, with the free borders a little flaring over the hind limbs and a little drawn in on each side of the midline behind. The region along the middle of the back is rather flat, and presents no traces of a keel. From the free border of the carapace in front of the axillary notch

a sharp carina passes backward over the bridge to the free border behind the inguinal notch. Possibly the acuteness of this has been accentuated by crushing.

The plastron projects considerably in front of the carapace. This does not appear to be due to any crushing, for the hinder end of the plastron approaches closely the border of the carapace.

The length of the carapace is 305 mm.; its width, 280 mm. All the free borders are acute. The nuchal has a length of 57 mm., a maximum width of 67 mm., and a width of 43 mm. along the free border. The first neural is oval, the second and fourth octagonal; the third, fifth, and eighth are 4-sided; the sixth and the seventh, hexagonal. The table shows their dimensions.

Dimensions of neurals.			Dimensions of costals.			Dimensions of vertebrals.			
No.	Length.	Width.	No.	Proximal width.	Distal width.	No.	Length.	Width in front.	Greatest width.
1	38	31	2	21	65	1	65	65	65
2	35	50	3	39	15	2	57	57	83
3	28	43	4	22	58	3	60	73	92
4	35	55	5	28	37	4	63	71	83
5	28	41	6	20	33	5	57	43	100±
6	18	50	7	17	26				
7	24	51							
8	26	26							

The costal plates are alternately wide and narrow at their proximal ends and narrow and wide at their distal ends. The widths are given in the table above.

The nuchal scute is 15 mm. long and 13 mm. wide. The dimensions of the vertebrals are herewith shown in tabular form.

The plastron has a length of 325 mm., being thus longer than the carapace. The anterior lobe is 100 mm. long and 148 mm. wide at the base. The epiplastral lip is 70 mm. wide at the ends of the gulo-humeral sulci and it projects beyond these a distance of 28 mm. The free borders of the lobe, including the lip, are acute. The anterior border of the lip is notcht. The thickening of the lip is continued backward a distance of 45 mm. from the front; it then drops off suddenly, forming an escarpment, which is somewhat excavated beneath. At the hyo-epiplastral suture the width of the superior horn-covered surface is 27 mm. The entoplastron is 61 mm. long and 58 mm. wide. The bridge has a width of 150 mm.

The hinder lobe is 55 mm. long at the midline, 70 mm. total, and has a width of 155 mm. at the base. Median notch 15 mm. deep and 55 mm. wide. Near the inguinal notch the free border of the lobe is about 17 mm. thick; more posteriorly it becomes thin and finally acute.

The gular scutes are 60 mm. long in the midline. The humerals occupy 54 mm. of the midline; the pectorals, 24 mm.; the abdominals, 95 mm.; the femorals, 40 mm.; the anals, 33 mm. The axillary and inguinal scutes are present, but small.

No. 1536 of the Carnegie Museum is a nearly complete shell, smaller than the preceding. It is referred to this species. It presents the difference of having a smaller epiplastral lip.

No. 1570 of the Carnegie Museum is also referred to the present species. It was obtained in 1902, by Mr. Earl Douglass, at Cold Spring, Montana, in what the discoverer regards as Upper Loup Fork beds.

The hinder parts of both carapace and plastron are wanting. The epiplastral lip does not project so much in front of the carapace as in the type, but this may be due to some distortion. The entoplastron is 52 mm. long and 60 mm. wide, differing thus somewhat from that of the type, whose entoplastron is longer than wide. Pectoral scutes 28 mm. wide at midline.

The surfaces of this shell and those of the type are sculptured by the growth lines of the epidermal scutes.

This species differs from *T. farri* in having the first vertebral scute much less expanded, in having the opposite ends of the costals more narrowed and more widened, and the epiplastral lip more strongly developt. It differs from *T. vaga* in having a more projecting epiplastral lip, a differently shaped entoplastron and pectoral scutes narrower at midline.

This species is dedicated to Dr. W. J. Holland, director of the Carnegie Museum, Pittsburg, Pennsylvania.

Testudo turgida Cope.

Testudo turgida, COPE, Proc. Amer. Philos. Soc., XXX, 1892, p. 127; Amer. Naturalist, XXVI, 1892, p. 50; 3d Ann. Report Geol. Surv. Texas, 1891 (1892), p. 255; 4th Ann. Report Geol. Surv. Texas, 1892 (1893), p. 47.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.—GIDLEY, Bull. Amer. Mus. Nat. Hist., XIX, 1903, p. 627.

The type specimen of the present species belongs to the University of Texas. It was discovered in the Blanco beds of the Pliocene, near Espuella, Dickens County, Texas. No figures of the species have ever been publisht. The writer examined the materials in the collection at the University of Texas, at Austin, but was not able to find Cope's type of the species. Remains of two or three other specimens of the species are in the collection, but a description of them would add little to what Cope has recorded. This author's description is here reproduced. That found in the Third Annual Report, as cited above, is identical with that found in the Proceedings of the American Philosophical Society. It runs as follows:

This species is represented by the greater part of a chelonite of about the size of the *Xerobates agassizii* of Arizona. It is remarkable for the remarkable depth of the dermal sutures and sculpture lines, and for the swollen character of the interspaces which separate both. The general shape is a short, wide oval, with steep to vertical margins.

The plastron is widely emarginate posteriorly, and the anal-femoral dermal sutures form a deep notch in the border. The anal scuta are oblique rhomboids, with equal and nearly parallel sides. The median longitudinal dermal suture is deep and wide, cutting half through the thickness of the plastron. It sends off a branch on each side bounding the gular plates in front. The part of the plastron inclosed in the latter forms two flattened cones appressed together, whose vertical diameter exceeds the transverse, and whose subconic apices are separated by a deep notch. The interclavicular bone is very large and is wide diamond-shaped, the anterior angle being larger than the posterior. The transverse humero-pectoral suture is very deep, and is similar to the median longitudinal. The borders of the anterior lobe are strongly convex, with a chord only twice as long as the lateral border of the gular plates.

The nuchal bone has a strongly concave-emarginate border. On the posterior vertebral bones is a seat-like cavity, which is surrounded by a ridge which forms the greater part of a circle. The costal bones are unequally divided by the costal dermal sutures, which are very deep. Each costal scutum is divided into two areas, one of which is marked with ribs parallel to the vertebral axis at one extremity and a seat-shaped plane with a bordering ridge at the other, which is in some of the costals smaller and more swollen. The other half or part of the scutal area is swollen in the longitudinal direction, but not for its entire length. The marginal bones are massive and have a subacute border between the bridge and the median points. They are much deeper than long, and are deeply divided by the sutures which separate the dermal marginals. These grooves cut the margin into deep notches at some points and into lower ones at others. The areas between these sutures are all swollen in the same way as the alternate parts of the costal plates.

MEASUREMENTS.

	Millimeters.		Millimeters.
Length of plastron anterior to posterior angle of interclavicle	80	Diameters of free marginal near bridge:	
Width of plastron anterior to posterior angle of interclavicle	112	Antero-posterior	20
Length of interclavicle	40	Vertical	34
Width of interclavicle	58	Transverse below	25
Thickness of interclavicle	11	Diameters of marginal of bridge:	
Length of free lateral margin of gular plate	29	Antero-posterior	29
Width of base of both gular plates	45	Vertical	44
Length of xiphiplastral bone	32	Transverse below	21
Width of xiphiplastral bone on anterior suture	53	Diameters of penultimate vertebral bones:	
Width of emargination of posterior lobe of plastron	50	Antero-posterior	17
		Transverse	30

The American tortoise which has produced gular areas somewhat like those of this species is the *Testudo cultrata* Cope of the White River Neocene of Colorado. That species is however, totally different in the dermal sutures of the usual character, flat marginals, etc., and the gular processes are not conic, but trihedral in form.

The specimen above described comes from Espuella, near Dockum, from the same horizon as that of Crosby County, or the Blanco beds of Cummins.

In the Fourth Annual Report, as cited in the synonymy, Professor Cope stated that 7 specimens of this species were found together at one locality, which did not yield any other vertebrate remains. Fragments of 2 other individuals were found at other localities in direct association with Mammalia.

Testudo pertenuis Cope.

Fig. 609.

Testudo pertenuis, Cope, Proc. Acad. Nat. Sci. Phila. 1892, p. 226; 4th Ann. Report Geol. Surv. Texas, 1892 (1893), p. 47, figs. 1, 2.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.—Gidley, Bull. Amer. Mus. Nat. Hist., xix, 1903, p. 627.—Montgomery, Biol. Bull., viii, 1904, p. 57.

The type and only known specimen belongs to the University of Texas. It was discovered by Professor Cope in the year 1892, in the Blanco beds of the Pliocene, near Mount Blanco, Crosby County, Texas. Of this species the writer found in the University of Texas only three or four large fragments which had been glued to sheets of paper. These fragments may or may not belong to the type. The thickened portions of the anterior and posterior lobes of the plastron appear not to have been preserved. It seems probable that the type was injured before being returned to the collection at Austin. Under the circumstances, nothing more can be done than to republish Cope's description and his apparently more or less diagrammatic illustration (fig. 609). In this figure, 1 represents the carapace and part of the front of the plastron seen from above. The other part of the figure, 2, shows the hinder lobe of the plastron as seen from above.

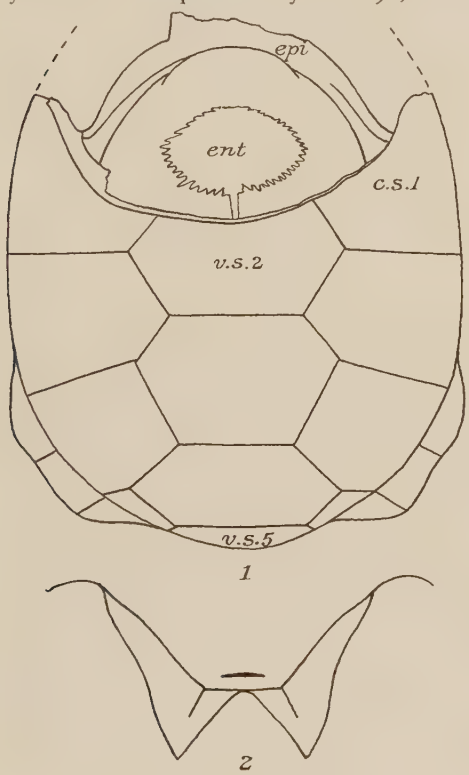


Fig. 609.—*Testudo pertenuis*. ×$\frac{1}{15}$.

c.s. 1, first costal scute; *ent*, entoplastron; *epi*, epiplastron; *v. s.* 2, *v. s.* 5, first and fifth vertebral scutes. From Cope's figure.

Founded on a large specimen measuring three and a half feet in length by three in width, and remarkable for the transverse width of the vertebral dermal scuta. The carapace is rather flat and descends steeply posteriorly, the anal marginal bone being somewhat incurved. Margins of carapace flare outwards above the legs. The plastron has a rather wide lip, with flat base and straight lateral borders; its anterior border is lost. The posterior lobe is deeply and widely notched, terminating on each side in a subequilateral angular prominence. Both carapace and plastron are without sculpture, the posterior angles of the plastron only being longitudinally grooved below. The vertebral scuta are considerably wider than long, as is also the anal scutum. Both carapace and plastron are very thin, not exceeding one-quarter inch in the specimen described, except at the borders.

Measurements.

	Feet.		Feet.
Length over all	4.2	Length of last costal	.95
Width over all	4	Width of lip of plastron at base	.8
Width of penultimate dorsal scute	1.275	Width of anterior lobe at axillæ	2
Length	.85	Width of posterior lobe of plastron at base	2
Width of last vertebral scute	1.35	Width at fundus of median notch	1.1
Width of anal scute	1.5	Width at apices of angular processes	.85
Length	.6	Depth of notch	.5
Length of penultimate costal scute	.9		

This is the largest species of land-tortoise yet known from North America.

In its broad, deprest shell, with its broad vertebral scutes, this species appears to have resembled somewhat *T. pansa*, of the Pawnee Miocene. It differs, however, in several important respects. The carapace of *T. pertenuis* is said to descend steeply behind and to have the pygal somewhat incurved. In *T. pansa* the rear of the shell slopes gradually downward and backward, and the pygal is not at all incurved. The shell of *T. pertenuis* is stated to have the borders flaring over the limbs, a condition not true in *T. pansa*. The vertebral scutes of

T. pertenuis were evidently wider than those of *T. pansa*. In the former the penultimate vertebral had a width equal to 0.36 of the whole length of the carapace; while in *T. pansa* the corresponding scute has been only 0.26 as long as the carapace. The epiplastral lip of *T. pertenuis* has had straight and, according to Cope's figure, parallel lateral borders.

Testudo campester sp. nov.

Figs. 610–613.

Testudo campester, HAY, Bull. Amer. Mus. Nat. Hist., XIX, 1903, p. 627, in paper by J. W. Gidley and without description.

The remains on which this species is based were collected for the American Museum of Natural History during the summer of 1900, by Mr. James W. Gidley. They were found in the Blanco beds of the Pliocene deposits, near Mount Blanco, Crosby County, Texas. The materials all belong to one individual, and consist of the nearly complete plastron, the lateral and the posterior peripherals from one inguinal notch to the other, a portion of the nuchal bone, 2 neurals and parts of a few others, and portions of several costals. The shell originally had a length of about 730 mm. and a width of at least 560 mm. It was apparently of moderate convexity and of medium height. The number of the specimen is 3930.

The greater portion of the plastron (fig. 610) is present, but it has suffered some damage thru decay of the bone and loss of fragments. The total length equals 670 mm. It is somewhat concave in the hinder half, and the anterior lobe was lifted above the plane of the rest of the plastron. The length of the anterior lobe equals 180 mm.; its width, at the axillary notch, has been close to 325 mm. From the axillary notch the outline of the anterior lobe is moderately convex as far as the gular suture; from this point the outline changes its course and runs in a straight line forward and inward to the outer anterior angle of the lip.

The lip was quite prominent. Owing to some damage to the plastron in this region its width can not be determined with all desirable exactness; but it was very close to 125 mm. Its front is truncated or slightly convex and probably without notch; but the portion present does not extend to the midline. The width of the base at the gular sutures was about 175 mm.; the length in the midline about 80 mm. The upper surface is slightly convex from the midline to the lateral border, and this convexity is continued backward to the posterior end of each of the epiplastra. Antero-posteriorly the lip is very slightly convex above. The lower side of the lip is convex both longitudinally and transversely. This convexity diminishes backward, so that the hinder ends of the epiplastra are nearly plane. The free border of the epiplastra from near the midline of the lip to their hinder ends is rather sharply rounded. From this border the bone thickens rapidly, so that at the middle of the length and breadth of the epiplastron the thickness equals 46 mm., while at its hinder end the thickness is 37 mm.

Seen from above the thickness of the lip continues backward for about 100 mm. and then becomes suddenly reduced. Whether or not there was an excavation behind the thickened portion is uncertain.

Altho the entoplastron and the borders of the epiplastra joining it are somewhat eroded, it is evident that the entoplastron itself was transversely oval. Its transverse width was close to 160 mm.; its antero-posterior extent about 130 mm.

The antero-posterior extent of the hyoplastra in the midline is 155 mm. That of the hypoplastra is almost exactly the same. The xiphiplastra meet along the midline for a distance of 105 mm. At their anterior ends each has a width of 130 mm.

The posterior lobe of the plastron has a total length of 105 mm., and it is nearly 300 mm. wide. At its hinder extremity there is a right-angled notch whose width behind is 90 mm. and whose depth is 45 mm.

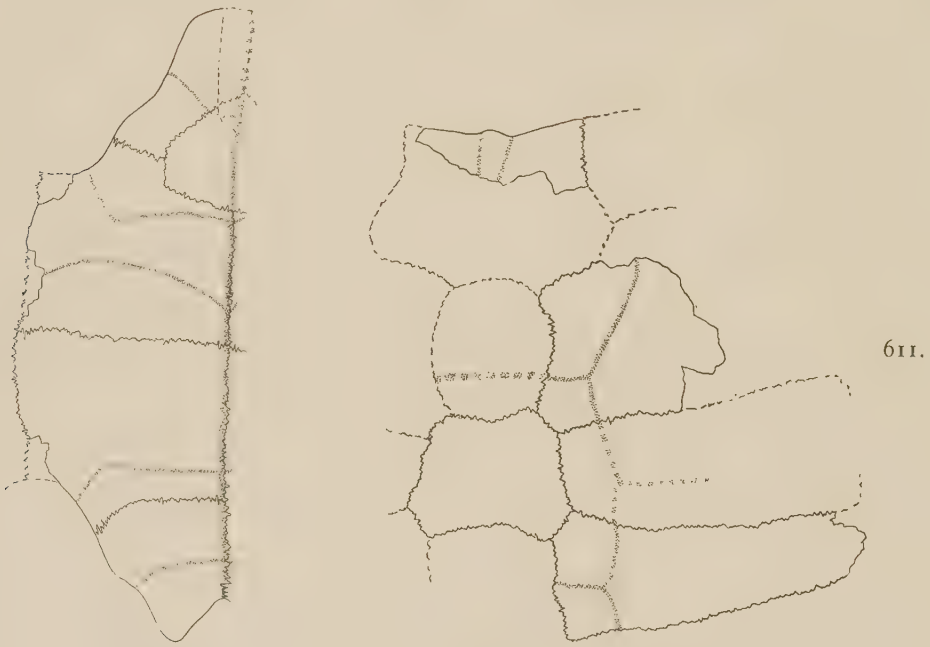
Seen from above, the posterior lobe presents a broad, shallow basin, surrounded at the sides by a bony wall. Just behind the inguinal notch this wall rises, from the lower side of the plastron, to a height of 55 mm. Here the outer face of the bone overhangs somewhat. Further behind, the wall descends, and the outer face looks more and more upward and the summit of the wall is rounded off. From the posterior part of this summit a low ridge runs to the tip of each of the terminations of the plastron.

Most of the sulci separating the dermal scutes of the plastron are remarkable for their depth. Along the midline runs a groove so deep as to cut halfway thru the bone, and of about

15 mm. in width on the hinder lobe, and 30 mm. at the junction of hyoplastra and hypoplastra. The width on the entoplastron can not be determined, but it has caused the latter to break along the midline. The gular sulci are not distinct, but they appear to have been broad, and they extended on the entoplastron. The humero-pectoral sulcus starts, narrow and well imprest, at the axillary notch, runs backward and inward nearly 75 mm., then turns sharply and runs directly across the plastron, passing behind the entoplastron. The sulcus between the pectorals and the abdominals is convex forwards. Laterally the pectorals have a width of only 45 mm., but at the midline they are 75 mm. wide. The abdominals have a width of 175 mm. along the midline. The sulcus between these and the femorals is wide and deep, and it runs directly across the plastron in front of the inguinal notches. The femorals extend 80 mm. along midline. The anal scutes meet along the midline for a distance of about 50 mm.

The inner half of the lower surface of each hypoplastron is markt by longitudinal grooves.

The remains of the carapace (figs. 611, 612, 613) of this species testify that it is a true *Testudo*. One of the neurals (fig. 611) is octagonal, and the few costals present show that some



FIGS. 610 AND 611.—*Testudo campester*. No. 3930 A. M. N. H.

610. Plastron. ×⅛. Partly restored in front.
611. Portion of anterior half of carapace. ×¼. Most of nuchal and whole of first neural restored.

were broad at the proximal end and narrow distally, while others were narrow proximally and wide distally.

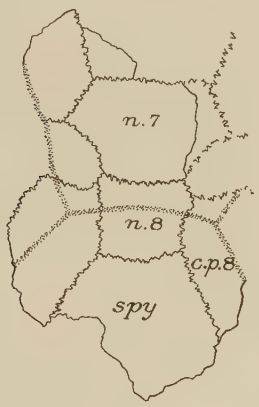
The large octagonal neural is the second in the series. Its fore-and-aft diameter along the midline is 67 mm.; its width across the middle of the length is 86 mm. The sides are concave, the angles truncated. The third costal articulated with the right hinder angle of the second neural. Its greatest width is 87 mm.; its distal width was about 50 mm.; its length about 240 mm. The second vertebral scute was about 160 mm. wide from side to side.

There is present the upper end of another costal plate, probably the fourth on the right side. The upper end is 48 mm. wide; the lower end of the fragment, perhaps a third of the costal, is 75 mm. wide.

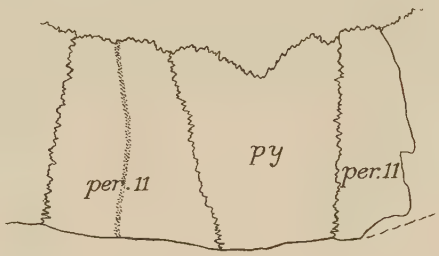
The proximal portion of the right first costal is among the remains. Its proximal end is 100 mm. wide and most of this is concave and was in contact with the first neural. The latter must therefore have had convex sides. On the outer half of the upper surface of the first costal, are several deep, wide, and curved grooves, which mark the stages of growth of the scute which covered it. Similar grooves are found on other costals. The costals are about 13 mm. in thickness.

A portion of the rear (fig. 612) of the carapace along, and for a short distance on each side of, the midline is preserved. It includes the left hinder corner of the hexagonal sixth neural. This is seen to have had a width, across the hinder end, of 74 mm. Behind it is a little more than the left half of the seventh neural. This is broadest in front, and hexagonal, thru having the anterior angles truncated; and with a maximum width of about 90 mm. The fore-and-aft extent was about 50 mm. It is succeeded by the eighth neural, which has a length of about 40 mm. and a width of about 45 mm. Behind this is a fragment of the first suprapygal. On it are indications of the fourth and fifth vertebral scutes. The exact length and breadth of these can not be determined. The fourth was 80 mm. wide behind and the width increases forward; while the fifth is 80 mm. broad at its anterior end and expands rapidly backward.

The thickened marginal portion of the nuchal bone (fig. 611) is among the remains. Its extent along the front is about 105 mm. It is slightly emarginated at the midline, the edge is abruptly rounded and from the front it thickens rapidly backward, until at a distance of 40 mm. from the edge it is 42 mm. There appears to have been a nuchal scute 20 mm. wide. It is quite probable that all the anterior peripherals were thickened and had obtuse edges. Large portions of the peripherals from the axillary notches backward are present. Those behind the inguinal notches are higher than long; subacute at the free borders, nearly vertical, not flaring, except that the second and third on each side of the caudal peripheral flare slightly. The first behind the inguinal buttress is 160 mm. high. Behind this the others descend, until the pygal (fig. 613) is 115 mm. high at its lateral border. They are all about 80 mm. long at their free



612.



613.

613*a*.

FIGS. 612 AND 613.—*Testudo campester*. Portions of rear of carapace of type. $\times\frac{1}{4}$.

612. *c.p.* 8, eighth costal plate of type; *n.* 7, *n.* 8, seventh and eighth neurals; *spy*, suprapygal.
613. Pygal and eleventh peripherals. *a*, section of eleventh peripheral; *per.* 11, eleventh peripheral; *py*, pygal.

borders. The pygal is notcht at its upper border for the second suprapygal, 95 mm. wide at this border, and 65 mm. wide at the free border. The thickness of the peripherals is about 40 mm.; where they articulate with the costals and the pygal the thickness is about 15 mm. The free border of the peripherals is very slightly notcht where it is crost by the sulcus.

It is proper to compare this species with others which have been described from the Pliocene deposits.

T. crassiscutata (Leidy, Trans. Wagner Free Inst., II, 1899, p. 31, plate vi) differs in having the plastron much broader at its hinder end and with a much wider and shallower notch. The lip of the anterior lobe is also different.

T. hexagonata Cope, of the Equus beds of Texas (4th Ann. Rep. Geol. Surv. Texas, 1893, p. 77, plate xxii, fig. 2) has both anterior and posterior lobes of the plastron quite different. Especially is it stated that the sulci defining the pectoral scutes in front and behind approach each other at the midline. In *T. campester* these sutures are far apart at the midline.

T. laticaudata Cope, of the Equus beds of Texas (op. cit., p. 75, plate xxii, fig. 1), has the anterior lip of the plastron notcht in the middle so as to be doubly convex, and the lower side of the lip has two longitudinal fossæ. The posterior lobe, with its notch, is also different, the notch being much wider and much shallower.

T. pertenuis Cope, of the Blanco beds of Texas (op. cit. p. 47, figs. 1, 2), is a large species with the bones of the carapace and plastron not exceeding about 6 mm. in thickness, except at the borders. The bones are also devoid of sculpture. The depth of the posterior notch at the plastron is very nearly half the width of the plastron at the bottom of the notch. In *T. campester* the depth of the notch is not one-third of the width of the plastron at the point indicated. The vertebral scutes of *T. pertenuis* were much wider than in *T. campester*. Those of our specimen of the latter would be about 250 mm. wide if their ratio to the length of the animal were the same as in *T. pertenuis*.

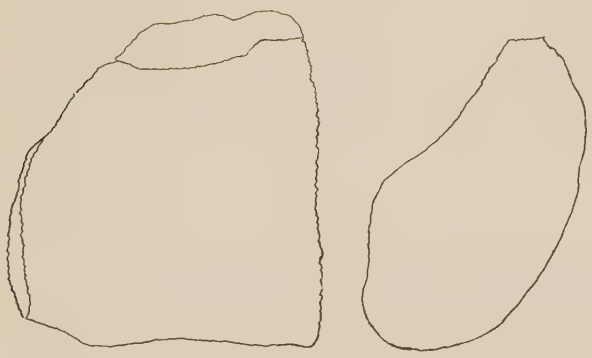
T. turgida (Proc. Amer. Philos. Soc., XXX, 1892, p. 127) has not been figured. It also is from the Blanco beds of Texas. So far as known it is a small species. The anterior lip is described as resembling two "flattened cones apprest together, whose vertical diameter exceeds the transverse and whose subconic apices are separated by a deep notch." Relatively to the size of the animal the hinder plastral notch was much wider than it was in *T. campester*. Other important differences appear on comparison of the descriptions.

Testudo obtusa (Leidy).

Figs. 614, 615.

Eupachemys obtusus, LEIDY, Jour. Acad. Nat. Sci. (2), VIII, 1877, p. 232, plate XXXIV, figs. 4, 5.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 448.
Eupachemys rugosus, LEIDY, Trans. Wagner Free Instit., II, 1889, p. 29 (*errore*).

Dr. Leidy's *Eupachemys obtusus* was based on a single peripheral bone which was sent to him by Prof. F. S. Holmes, this bone having been found in the phosphate beds of Ashley River, South Carolina. The exact age of the fossil is impossible of determination; but its time of existence was undoubtedly somewhere between the end of the Eocene and the beginning of the Pleistocene. Dr. Leidy founded for this turtle the new genus *Eupachemys*, but he did not attempt to define it. This name and the fact that he compared the bone with a peripheral of *Emys* seem to indicate that he believed the relationships of the animal to be with the aquatic emyds. The bone was evidently derived from a turtle about a meter in length. None of the Emydidæ attains such great size, and without other evidence the probability would be that the animal was a species of *Testudo*. To this genus it is here referred. There are some reasons for suspecting that it is the same turtle that was later described by Leidy under the name *Testudo crassiscutata*. However, until more is known about the two forms it seems best to retain them distinct.



614. 615.

FIGS. 614 AND 615.—*Testudo obtusa*. Outline and section of type peripheral. $\times \frac{1}{3}$.

614. Outline of upper surface. 615. Section at posterior end.

Dr. Leidy regarded the bone described by himself as probably the eighth of the left side. If this were true the anterior end might be expected to be thicker than the posterior; but of this we have no evidence. The fore-and-aft extent of the bone (fig. 614) is 120 mm. The height at the posterior end is 136 mm.; the greatest thickness, 72 mm. At the costal border the bone is thinned down to 15 mm. The lower, or free, border (fig. 615) is obtuse, a rare condition in turtles. What Leidy regarded as the upper surface, and probably correctly, rises in a prominent fore-and-aft ridge just below the middle of the height. From this ridge to the costal border the surface is concave; from the ridge to the free border, it is plane. The lower, or inner, surface is strongly convex from the costal to the free borders. The upper surface of the bone is rough and eroded. It exhibits no sulci separating the marginal scutes. The inner surface is smooth and presents a longitudinal sulcus running along near the costal border and more feeble indications of another that ran between the two

marginal scutes which occupied the bone. In fig. 615, which represents the posterior end of the peripheral, the outer surface is toward the left hand.

In the collection of turtle remains from Peace Creek, Florida, Dr. Leidy found a thick and rounded peripheral which he thought (Trans. Wagner Free Inst., II, p. 29) might belong to his earlier publisht *Eupachemys obtusa*, which he referred to mistakenly under the name *Eupachemys rugosus*.

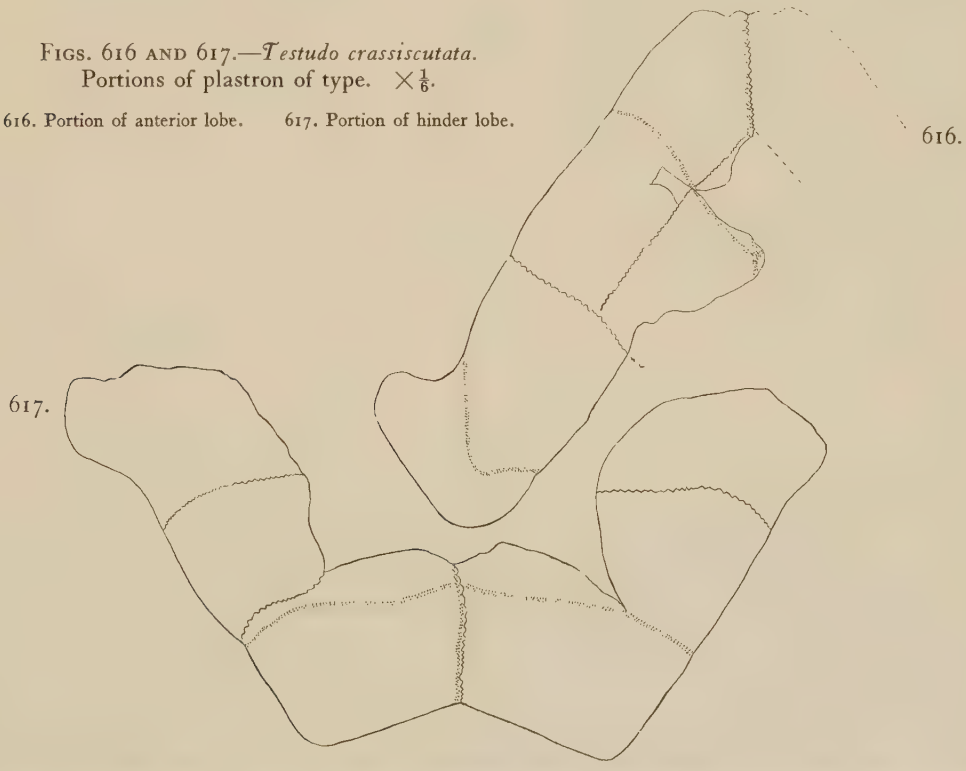
In the collection of the U. S. National Museum at Washington there is a large peripheral which was collected by Dr. W. H. Dall at Caloosahatchie, Florida. It has a length of 145 mm. The costal border is broken off. The free border is obtuse. The greatest thickness is 37 mm. It is possible that it belongs to the present species.

Testudo crassiscutata Leidy.

Figs. 616–624.

Testudo crassiscutata, LEIDY, Trans. Wagner Free Instit., II, 1889, p. 31, plate vi, figs. 4–7; Bull. U. S. Geol. Surv., No. 84, 1892, p. 129.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

The materials described by Dr. Leidy under the above name consisted of a number of fragments of one individual, mingled with a few fragments of the shells of two others. These remains indicated a tortoise whose carapace measured about 1520 mm. in length. The specimens are now in the U. S. National Museum and have the number 986. They were discovered in the Peace Creek beds, at Arcadia, Florida. As the type those bones must be taken which were figured by Dr. Leidy. These are the greater portion of the right epiplastron,



FIGS. 616 AND 617.—*Testudo crassiscutata.*
Portions of plastron of type. $\times \frac{1}{6}$.
616. Portion of anterior lobe. 617. Portion of hinder lobe.

wrongly mentioned by Leidy as the left, a portion of the right hyoplastron, the thickened borders of the hinder lobe of the plastron, the left femur, and the left tibia.

The anterior lobe of the plastron (fig. 616) had a length of 280 mm., measured at the mid-line, and a width close to 475 mm. at the base. Dr. Leidy gives the width as 520 mm.; but he measures outward to the middle of the axillary notch. From the base the lobe narrows rapidly to the front, where the width is about 80 mm. The lip does not project beyond the general curvature of the lobe, but it does project beyond the ends of the gulo-humeral sulci. From the

subacute free border of the lip the bone rises on the upper side to a point 105 mm. behind the front and then drops off suddenly. The greatest thickness attained is 70 mm. The upper surface of the lip is convex. There is no conspicuous notch where the gulo-humeral sulcus crosses the border.

The entoplastron was about 245 mm. wide. Its length is conjectural. It was pointed in front. Its greatest thickness at the midline is 70 mm., while the thickness of the hyoplastron is 46 mm.

The hinder lobe (fig. 617) had a length of about 160 mm. along the midline and a basal width of about 530 mm. Posteriorly there is a median notch 220 mm. wide and only 45 mm. deep. At the inguinal notch, on the upper surface of the lobe, a great wall begins and runs backward along the free border. The outer face of this wall is perpendicular and, at the notch, 100 mm. high. At the femoro-anal sulcus the height is 40 mm., and the outer face is inclined at an angle of about 45°. From the beginning the inner face slopes at an angle of about 45°.

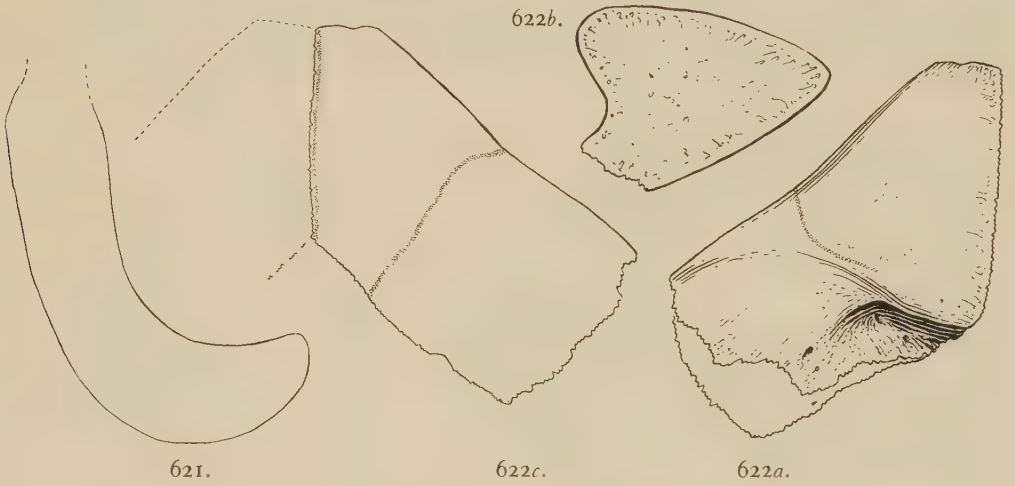
FIGS. 618–620.—*Testudo crassiscutata.* Neurals and costals. $\times \frac{1}{3}$.

618. Third and fourth neurals. 619. Costal bone. 620. Costal bone.

In the U. S. National Museum is a collection of fossil tortoise bones, No. 4963, which were collected near Tampa, Florida, by Mr. A. M. Lambert. They are believed to belong to this species. There are 2 successive neurals, the third and the fourth (fig. 618). They are remarkable for their size and great thickness. The third has a length of about 110 mm. and a width of 155 mm. It is crost by a deep sulcus. From each end of the bone the surface slopes toward this sulcus, so that the bottom of the latter is 15 mm. below the level of the ends of the bone. The fourth neural, like that of most other species of the genus, is much larger than the third and is octagonal in form. Its length is 130 mm.; its width, 200 mm.; and its thickness, 44 mm. Each side was in contact with the third, fourth, and fifth costals. An estimate makes it probable that the carapace of this individual was about 4 feet in length.

Fig. 619 represents the proximal end of a costal belonging to this collection, either the third or the fifth. Its greatest width is 150 mm., but at the distal end of the fragment the width is reduced to 111 mm. At the proximal end the thickness is 40 mm. Here it was in contact with

3 neurals. The median vertebral scutes of this individual must have been about 240 mm. long and about 300 mm. wide. A costal bone (fig. 620) very similar to this was figured by Dr. Leidy in F. S. Holmes's Post-Pliocene Fossils of South Carolina, plate xxviii, fig. 1. This was secured from the Ashley River deposits and its age is uncertain. It now belongs to the American Museum of Natural History. Its size is almost the same as that of the costal just described. The thickness is 33 mm. It appears to belong to the present species, and to furnish evidence that *T. crassiscutata* lived during the time when *T.* (*Eupachemys*) *obtusa* existed. On the other hand, Dr. Leidy (Trans. Wagner Free Instit., II, p. 29) mentions the finding, among bones collected at Peace Creek, Florida, of a peripheral that resembled that forming the type of *T. obtusa*. There is no certainty that *T. obtusa* and *T. crassiscutata* are not one and the same species, but for the present it may be better to regard them as distinct. With the neurals and the costal of No. 4693 of the U. S. National Museum there is a posterior peripheral. Its fore-and-aft extent is 115 mm. The height, following the curvature, is 220 mm. It curves upward as the free border is approacht. This border is acute. The greatest thickness of the bone is 35 mm. Prof. F. W. Putnam has given to the American Museum of Natural History some turtle bones that were dredged in the Alifia River, Florida. The beds are probably of the same age as the Peace Creek beds. Among these is a large peripheral, the length of which along the free border is 148 mm. Fig. 621 represents a section of this bone.



FIGS. 621 AND 622.—*Testudo crassiscutata.*

621. Section across a hinder peripheral. ×½. No. 6094 A. M. N. H.
622. Left epiplastral of young individual. ×⅔. *a*, upper surface; *b*, section of symphysis; *c*, lower surface.

As will be seen, it is much turned upward toward the free border. The thickness is 35 mm. The free edge is acute. It is possible that the obtuse peripheral forming the type of *T. obtusa* belonged to the anterior part of the carapace, while the acute-edged peripherals just described belonged posteriorly. Another peripheral from the Alifia River has a thickness of 48 mm. Its free border is eroded away; but as far as represented the upper surface is concave.

The Jarman collection of fossil bones, made in Hillsboro County, Florida, and now in Vanderbilt University, contains a left epiplastron which is referred with some doubt to this species (fig. 622, *a*, *b*, *c*). If it is correctly identified it belongs to a relatively young and small individual. The greatest length of the bone is 82 mm.; the bone of type of the species was 270 mm. long. The feature in which the present specimen differs from that of the type is the great thickness of the bone where it joined the epiplastron of the other side. In the type the greatest thickness of the epiplastron is 70 mm. If the present specimen retained the same proportions its thickness would be 21 mm. It is, however, 37 mm. thick. There is more or less variation in these beaks among the Testudos and for the present it seems best to refer this specimen to Leidy's species. In the same collection is a peripheral that appears to be the right ninth, with the costal border broken away. This peripheral has a length of 154 mm. along the free border. The greatest height of the bone, as preserved, is 186 mm. and this does not extend beyond the

costo-marginal sulcus. Where thickest, at the line where on the inner surface the horny scute met the soft skin, the bone is 45 mm.; elsewhere from 22 mm. to 30 mm. Considering the great thickness of the neurals and costals we might expect the peripherals of *T. crassiscutata* to be thicker than is the bone here described.

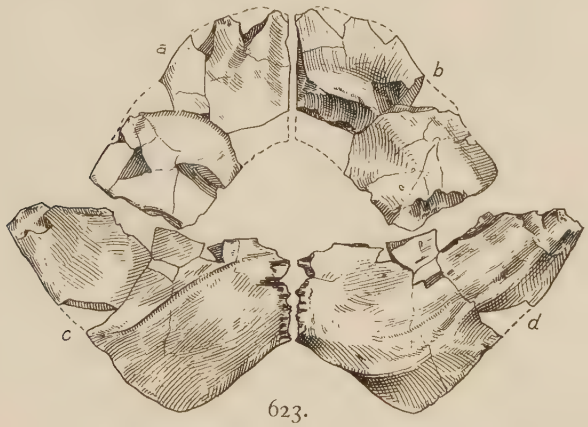
Testudo laticaudata Cooe.

Figs. 623, 624.

Testudo laticaudata, Cope, Geol. Surv. Texas, IV, 1903, reprint p. 75, plate xxii, fig. 1.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.

The type of Cope's *T. laticaudata* consists of a nearly entire right epiplastron, said by Cope to be the left, and the greater part of the right xiphiplastron. These remains were found by Prof. W. F. Cummins, of the Texas Geological Survey, in the Equus beds, on Rock Creek, opening into Tule Canyon, in Briscoe County, Texas. These bones are now in the University of Texas, where the writer has been permitted to examine them.

The form of the anterior lobe of the plastron, as far backward as the hyoepiplastral suture, can be seen from Cope's figure here reproduced. The width of the lobe at the suture mentioned was very close to 205 mm. The epiplastral lip was very slightly set off from the remainder of the lobe and was rounded and slightly tootht in front. The lower surface of the bone is in general flat, but on the lip there are two broad shallow fossæ. The free border is acute posteriorly, less so in front of the gulo-humeral sulcus. Along the epiplastral symphysis the bone thickens rapidly (fig. 624) rising to a height of about 42 mm. It then descends



623.

624.

Figs. 623 and 624.—*Testudo laticaudata.*

623. Right epiplastral and xiphiplastral bones forming type. ×⅓. *a*, right epiplastron, lower surface; *b*, upper surface of same bone; *c*, lower surface of right xiphiplastron; *d*, upper surface of same bone.
624. Section along symphysis of epiplastral bones. ×⅜.

perpendicularly until a thickness of about 20 mm. is attained. At the hyoepiplastral suture the thickness of the bone has become reduced to 19 mm. Along the suture mentioned the thickness is at first reduced slowly, then rapidly to the acute free border. The width of the bone along this suture is 54 mm. The entoplastron had a width of about 100 mm. Its length can not be determined.

On the lower side of the bone is seen a portion of the gulo-humeral sulcus. It crost the entoplastron, then ran outward and forward, then outward and slightly backward to the free border of the bone.

Figure 623 *c*, *d*, reproduces Cope's figures of the right xiphiplastron, the part on the right representing the upper side of the bone, that on the left the lower side. At the hypoxiphiplastral suture the free border is rather obtuse. From the border the bone thickens rapidly to a thickness of 25 mm. Further backward the free border becomes acute and the maximum thickness slightly less. At the midline behind it is 23 mm. The hinder angle of the bone is curved slightly upward. The horn-covered surface on the upper face of the bone reaches the free border at a distance of 15 mm. from the midline. The posterior notch was about 120 mm.

wide. On the lower surface of the bone is seen the femoro-anal sulcus, running parallel with the hinder border of the bone. The area occupied by the anal scute is rough and it occupies a slightly different level from the rest of the bone.

As stated by Cope, this species may belong to the genus *Gopherus* (*Xerobates*), but this can not be determined before the skull has been found.

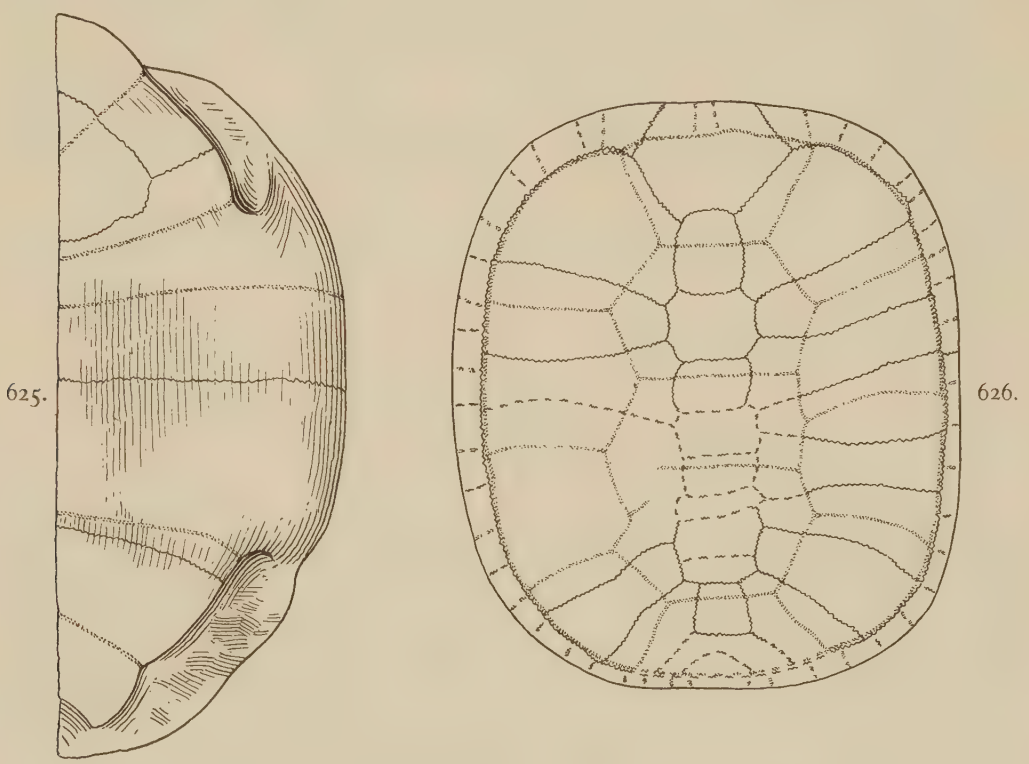
Testudo hexagonata Cope.

Figs. 625, 626.

Testudo hexagonata, COPE, Geol. Surv. Texas, IV, 1903, reprint p. 77, plate xxii, fig. 2.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 451.—GIDLEY, Bull. Amer. Mus. Nat. Hist., XIX, 1903, p. 623.

The present species is based on a specimen now in the University of Texas, at Austin, Texas, where the writer has been permitted to study it. The specimen was found by Prof. W. F. Cummins, of the Texas Geological Survey, in the Equus beds, on Rock Creek, a stream emptying into Tule Canyon, in Briscoe County, Texas.

The carapace of this shell is considerably crusht and fractured, and somewhat weathered. Various parts of the free border are missing. It is therefore difficult to secure the details of the structure, and this portion of the shell was not described by Cope. A figure is here presented (fig. 626) which gives as well as could be determined the structure of the carapace.



FIGS. 625 AND 626.—*Testudo hexagonata*. Shell of type.

625. Half of lower surface of shell. From Cope's figure. ×¼. 626. Carapace, partly restored. ×⅛.

The length of the carapace is 380 mm.; the width, 330 mm. The peripherals in front and behind the bridge appear not to have been flared upward to any considerable extent. Posteriorly the carapace appears to have been steep. Not much can be determined regarding the arrangement of the neurals, on account of distortion. The first had a width of about 45 mm. The second is octagonal, with a length of 45 mm. and a width of nearly 70 mm. The third was 4-sided. The second costal bone is narrowed proximally and greatly widened distally, being here about 65 mm. wide. The fourth and sixth costals have a similar form. The third and fifth are widened proximally and narrowed at the distal ends.

The vertebral scutes are wide and strongly angulated where their lateral boundaries join the intercostal sulci. The first is 130 mm. wide anteriorly and 70 mm. wide behind. The others have a maximum width of about 130 mm.

The plastron was described and figured by Cope. His drawing is here reproduced (fig. 625). When in Cope's hands the epiplastral lip was present, but this is now missing. The length of the plastron is given by Cope as 365 mm. This included the extremities of the hinder lobe on each side of the notch. The anterior lobe has a width of about 180 mm. and, according to Cope, a length of 89 mm. Cope states that the epiplastral lip had a simple regularly rounded outline, which was distinctly set off from the rest of the anterior border. From his description, confirmed by the impression on the matrix, the lip, at the symphysis, thickened rapidly backward on the upper surface. A section along the symphysis would closely resemble that of *T. laticaudata*. The thickness reacht was, according to Cope, 27 mm. The width of the lip at the base was 90 mm.; the length on the midline of its upper surface, 40 mm. The hinder face of the thickening was excavated to form a thoracic cavity. Posteriorly the epiplastra were greatly reduced in thickness, nowhere along the hyoepiplastral suture exceeding 11 mm. The bone thins gradually to the free border, so that the hinder part of the epiplastron differs considerably from that of *T. laticaudata*.

The entoplastron was of hexagonal form, about 60 mm. long and 80 mm. wide. The bridge has a width of 180 mm. The width of the hinder lobe may be regarded as 200 mm. Cope gives it as 240 mm., but he measures to the middle of the inguinal notches. The length, to the extremities of the hinder angles of the xiphiplastra, is 100 mm. The notch behind is about 80 mm. wide.

The gular scutes extended well backward on the entoplastron. The humerals extend 11 mm. behind the entoplastron, on the midline. The pectorals join at the midline a distance of 22 mm.; the abdominals, a distance of 120 mm.; the femorals, a distance of 42 mm.; the anals, a distance of 40 mm.

The free border of the xiphiplastron is acute from the hinder angle to near the hypoxiphiplastral suture. As the latter is approacht the bone thickens to 25 mm. and the free border becomes obtuse.

Cope states this species may belong to the genus *Gopherus* (*Xerobates*), but this can not be settled before the skull is found.

Testudo atascosæ Hay.

Figs. 627-628.

Testudo atascosæ, HAY, Proc. Acad. Nat. Sci. Phila. 1902, p. 383, figs. 1–5.

In the collection of the Academy of Natural Sciences of Philadelphia the writer has found certain bones which belong apparently to an undescribed species of the genus *Testudo*. These bones are accompanied by a label to this effect: "Miocene, E. W. Marnock, Atascosa County, Texas." There is no record of how this material came to the Academy. Mr. Witmer Stone has suggested that it may have been derived from Dr. Leidy's collection; we know also that Mr. G. W. Marnock collected in Atascosa County, Texas, for Professor Cope, but beyond this there is no indication that these bones were ever in the hands of either Professor Cope or Dr. Leidy. The initial "E" in the name above given is probably an error for G.

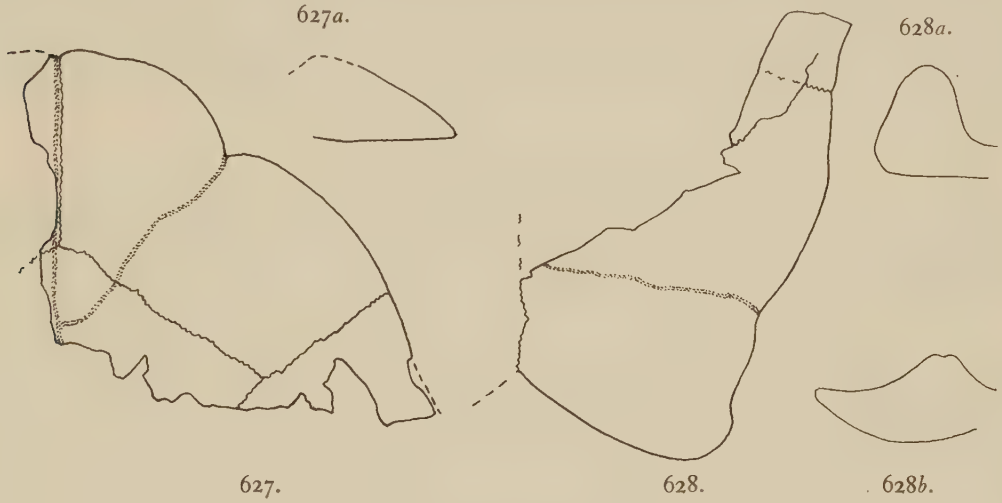
These remains consist of the left half of the anterior lobe of the plastron and the greater portion of the left side of the hinder lobe. Figures of these parts are presented (figs. 627, 628).

The species was one of considerable size. The xiphiplastron had a length of about 110 mm., the whole posterior lobe a length approximately of 120 mm. The anterior lobe had about the same length. We may perhaps safely estimate 200 mm. for the length of the bridge, thus making the plastron 440 mm. long.

The anterior lobe (fig. 627) was close to 200 mm. in width. The entoplastron had a width of 100 mm.; its length was probably about 80 mm., but its hinder border is missing. The gular scutes encroach on its anterior border. A broad rounded lip projected beyond the gulohumeral sulci about 28 mm. It had a width of 80 mm., and is not notcht in front. The whole border of the anterior lobe is acute, thru the beveling off of the upper side. Figure 627 represents a section thru the lip at the midline and shows this beveling. The greatest thickness at

the lip is 23 mm.; at a point halfway to the axillary notch this thickness is reduced to only 21 mm.; near the notch it is about 10 mm. Superiorly the lip extends back about 50 mm. From the summit of the lip two ridges, with a shallow valley between them, run toward the axillary notch, diverging gently. There was evidently no thoracic excavation in the hinder face of the lip.

The posterior lobe (fig. 628) was broadly notcht behind, the notch having a width of about 90 mm. and a depth of 35 mm. The terminal lobules are directed outward and upward, ear-like, somewhat as they are in *Gopherus polyphemus*, but not so narrow as they are in the latter. From the midline behind, the border is acute around the lobules and as far forward as about 35 mm. behind the hypoxiphiplastral suture. Here it rather suddenly becomes broadly rounded as shown by the cross-section (fig. 628*a*). At the suture mentioned the thickness of the bone is 30 mm. The wall thus formed continues backward, descending somewhat, and meets the



FIGS. 627 AND 628.—*Testudo atascosæ*. Plastron of type. $\times\frac{1}{2}$.

627. Anterior lobe; *a*, section of epiplastral symphysis.
628. Hinder lobe; *a*, section at hypoxiphiplastral suture; *b*, at extremity of xiphiplastron.

midline 15 mm. or more in front of the bottom of the notch. Fig. 628*b* presents also a section thru one of the lobules in a direction from its tip toward the center of the hinder lobe. The greatest thickness is 22 mm.

The femoro-anal sulcus runs from the midline outward, so as to make the outer end of the anal scute somewhat wider than the mesial end. Antero-posteriorly, at the middle of its width, the scute is 40 mm. long.

The deposits in which this tortoise was found belong to the Equus beds of the Pleistocene.

In the same region Mr. Marnock collected *Terrapene marnochi* (Cope) and *Trachemys bisornata* (Cope) (Proc. Amer. Philos. Soc., XVII, 1878, pp. 228, 229; Amer. Naturalist, XXIII, 1889, p. 161).

It is not improbable that this species belongs to the genus *Gopherus*.

Superfamily TRIONYCHOIDEA.

Thecophora with skull and neck in all essential respects like the same parts in the Cryptodira. Horny jaws concealed beneath fleshy lips. Peripheral bones rarely present. Plastron ligamentously connected with the carapace. Epiplastra separated from the hyoplastra by the entoplastron. Pelvis not suturally connected with the carapace and plastron. So far as known, no epidermal scutes.

Of the Trionychoidea, 2 families are here recognized—the Trionychidæ and the Plastomenidæ. The former family is represented by numerous living species; the latter is extinct.

In his Bibliography and Catalogue of the Fossil Vertebrata of North America, constituting Bulletin No. 179 of the U. S. Geological Survey, publisht in 1902, the author regarded

the Trionychoidea as one of three suborders of the Testudines, the other two being the Athecæ and the Thecophora. Further consideration of the subject has convinct him that the group is too closely related to the Cryptodira to justify such a wide separation of the two. On the other hand, there are structural differences of too great value to permit the trionychids to be reduced to the status of one or two families under the Cryptodira. It is now believed that their relationships to other turtles will be correctly exprest by making them a superfamily of the Thecophora, the other superfamilies being the Amphichelydia, the Cryptodira, and the Pleurodira. This classification is that adopted by Dr. Boulenger in his Catalogue of Chelonians, etc., in the British Museum.

For a discussion of the structure and relationships of the trionychids the reader is referred to Baur's papers in the Zoologischer Anzeiger, vol. x, 1887, p. 96; vol. xi, 1888, p. 736; vol. xii, 1889, pp. 241–243, and American Naturalist, vol. xxiv, 1870, p. 530; Dr. Boulenger's catalog referred to above, and to a paper by the present writer (Bull. Amer. Mus. Nat. Hist., xi, 1905, pp. 137–175). For a discussion of Haeckel's view that the Trionychoidea are the most primitive of the Thecophora the reader is referred to page 25 of the present work.

The geographical distribution of the living Trionychidæ is discust on page 35 and is illustrated by fig. 16.

Family PLASTOMENIDÆ Hay.

Trionychoidea with skull like that of the Trionychidæ. Neck unknown, but probably like that of the Trionychidæ. No peripheral bones. Epiplastra separated from the hyoplastra by the large, crescentic entoplastron. Hyoplastra, hypoplastra, and xiphiplastra closely united, as in the Emydidæ. Feet unknown.

Up to the present time only one genus is known which may be referred to this family—the genus *Plastomenus* Cope. The structure of this, so far as determined, has been learned from the Bridger species. The cervical vertebræ and the feet are unknown.

The Plastomenidæ differ from the Trionychidæ, so far as known, principally in the structure of the plastron. In the latter family the ventral armor differs much from that of the Cryptodira. The bones have suffered reduction, so that great fontanels intervene between the bones of the opposite sides and between the entoplastron and the hypoplastra. The entoplastron is V-shaped and excludes the epiplastra from the hypoplastra. In the Plastomenidæ the three hinder pairs of bones join their fellows closely at the midline, as in the Cryptodira, and the hypoplastra are closely sutured to the hyoplastra and to the xiphiplastra. There appears to have been little space between the entoplastron and the hypoplastra. Indeed, the plastron is more completely closed than in the Chelydridæ and Cheloniidæ. Furthermore, the entoplastron, if we may form our conclusion from *Plastomenus ædemius*, was broad fore and aft and elongate kidney-shaped. We do not know what were the form and connections of the epiplastra.

A peculiarity of structure displayed by some species of the family is the great development of the eighth pair of costals. In most species of Trionychidæ the eighth costals are greatly reduced and in some cases wholly wanting. In *Plastomenus thomasi* and some other species this pair of costals is greatly developt. The character does not, however, appear to be shared by all the species.

Genus PLASTOMENUS Cope.

At the present time the generic characters of *Plastomenus* can not be separated from those assigned above to the family. So far as known there is present a preneural bone, and some of the hinder neurals are wanting.

Type: *Plastomenus thomasi* Cope.

Professor Cope's first definition of the genus *Plastomenus* (Proc. Acad. Nat. Sci. Phila. 1873, p. 278) is hardly sufficient to distinguish it from other trionychids. For a reason which the present writer does not understand he concluded that there was present "a nuchal marginal which does not exist in *Trionyx*," but no such bone has been shown to have existed. He was

especially struck by the configuration of the inner end of the hyoplastral bone, which appeared to him greatly different from that of *Trionyx;* but he does not mention the condition of the median and hinder portions of the plastron.

In 1877 (Wheeler's Surv. 100th Merid., IV, p. 47), Cope concluded that the hyoplastrals were not greatly different from those of *Trionyx*, while the hypoplastrals were materially different. They are stated to have displayed a transverse width behind the inguinal region more like an emydoid than a trionychoid genus. The more extended ossification of all these bones in *Plastomenus* than in other genera of trionychids was recognized. Cope's remarks on the genus in the work referred to were copied into his work of 1884 on the vertebrates of the Tertiary formations.

Even as late as the year 1882 (Amer. Naturalist, XVI, 991) Professor Cope was uncertain whether or not this genus belonged to the Emydidæ.

Several of the species referred to this genus are based on very fragmentary and incomplete materials, and it is not improbable that when more complete remains shall have been discovered some of these species will have to be placed in other genera.

Analysis of Species Referred to Plastomenus.

A^1. Judith River and Laramie species:
1. Costals with angular pits, 5 in 10 mm., and crost by prominent welts ..... *costatus*

A^2. Arapahoe species:
2. Costals without welts; pits fine, not angular, 6 in 10 mm ..... *punctulatus*
3. Costals not known; free border of hypoplastron acute; lower surface with angular pits ..... *insignis*

A^3. Puerco or Torrejon species:
4. Carapace with welts. Carapace and plastron with small pits ..... *acupictus*

A^4. Wasatch species:
5. Like *P. thomasi*, but ridges between pits broader; 7 pits in a line 15 mm. long *catenatus*
6. Costals thick; pits on distal ends of costals in rows; 3 or 4 pits in a line of 10 mm. *leptomitus*
7. Costals thick; sculptured with pits and welts; pits circular, 7 on 10 mm ..... *lachrymalis*
8. Costals of moderate thickness, pits angular, 7 in 10 mm; some of the intervening ridges weltlike ..... *fractus*
9. Pits of costals abruptly sunken; 5 in 10 mm.; no welts; plastron with vermiculate ridges ..... *corrugatus*
10. Costals thick; pits circular, 4 in 10 mm.; oblique welts on some costals; plastron with rows of circular pits ..... *communis*

A^6. Bridger species:
11. Carapace with welts and pits; four pits in a 10 mm. line. Costals of eighth pair as long as wide ..... *thomasi*
12. Carapace with welts and pits; five or six pits in 10 mm.; eighth costals much shorter than broad ..... *visendus*
13. Carapace with welts and pits; eight pits in 10 mm.; hinder costals about as long as wide ..... *tantillus*
14. Carapace with welts on hinder end; three or four pits in 10 mm ..... *ædemius*
15. Like *ædemius* but with from five to seven pits in 10 mm ..... *molopinus*

Plastomenus costatus Cope.

Plate 85, figs. 1, 2.

Plastomenus costatus, Cope, Vert. Cret. Form. West, 1875, pp. 94, 261, plate viii, fig. 8; Proc. Acad. Nat. Sci. Phila. 1875, p. 9; Brit. N. A., Bound. Comm. Report on Geol. etc., 1875, p. 337.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.—Hatcher, Bull. U. S. Geol. Surv. No. 257, p. 74.

This species was described from materials collected by Dr. G. M. Dawson, south of Wood Mountain, Assiniboia. The deposits from which they were derived were supposed to belong to the Laramie, but are now known to belong to the Judith River. These materials are now the property of the Geological Survey of Canada. They consist of a piece of a costal, a fragment of probably the right hypoplastron, and another small undetermined fragment. The costal fragment was figured by Cope as cited. The bone is remarkable for the relative thick-

ness of the portion occupied by the rib. Some of Cope's measurements appear to be slightly erroneous. The thickness of the edge of the bone is nowhere quite 5 mm.; where thinnest only 3 mm. The thickness thru the rib is a little less than 9 mm. The border of the plastral fragment is 10 mm. thick. The ornamentation of the surface of the costal is distinct and peculiar. There are about 5 of the angular pits in a line 10 mm. long.

The fragment of the plastron appears to be a portion of the right hypoplastron extending from the inguinal notch backward. There are some indications that it extended to the xiphiplastral suture. The free border is rounded.

There are in the American Museum some portions of a carapace and a plastron which were collected by Mr. Barnum Brown in 1902, in Laramie deposits, 12 miles south of the Missouri River, on Hell Creek. The locality is 130 miles west of Miles City, Montana. It is not certainly known that the various bones belong to the same individual. Their number in the American Museum is 6131. Figure 1 of plate 85 represents the distal end of one costal, as seen from the upper surface. The thickness at the articular border is 5 mm.; that thru the rib is 8 mm. In this specimen, as in Cope's type, the rib stands out on the lower surface of the bone with great distinctness. It likewise extended a considerable distance beyond the free border of the costal. These borders are beveled off obliquely to the upper surface. The ornamentation consists of a network of ridges, which anastamose irregularly and inclose pits and winding and interrupted valleys. The ridges are rather low, and there are from 4 to 6 of them in a line 10 mm. long. On the costal plate here figured we find 2 welts crossing it, such as we find in *P. thomasi*. Another costal does not show these.

Figure 2 of plate 85 represents the right xiphiplastron. A comparison of this bone with that of *P. thomasi* will reveal many similarities. There is no doubt that this bone articulated with the one of the opposite side thruout its entire length. At the anterior end of this median border there are two processes which entered pits in the opposite bone and received between them a process from that opposite bone. The anterior border also almost certainly articulated its full length with the hypoplastron. At the outer anterior angle there are two strong processes for digitation with the hypoplastron. At the base of these processes the thickness is 12 mm.; while at the median border the thickness is 5 mm. The sculpture of the bone agrees well with that of the portion of plastron described by Cope. It is similar to that of the carapace but the pits are not so deeply imprest. It covers the whole lower surface of the bone.

Plastomenus? punctulatus Cope.

?Plastomenus punctulatus, Cope, Ann. Report U. S. Geol. and Geog. Surv. Terrs., 1873 (1874), p. 453; Bull. U. S. Geol. and Geog. Surv. Terrs., 1, No. 2, 1874, p. 29; Vert. Cret. Form. West, 1875, pp. 94, 261, plate vi, fig. 9.

?Plastomenus punctulatus, Cope, Bull. U. S. Geol. and Geog. Surv. Terrs., III, 1877, p. 573.

Plastomenus punctulatus, Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 453.—Hatcher, Bull. U. S. Geol. Surv., No. 257, 1905, p. 74.

Cope's type of the present species consists of only a fragment of a costal plate, which the describer figured in his monograph on Cretaceous vertebrates, as cited above. This type is now in the American Museum and has the catalog number 1845. It was collected in northeastern Colorado, in association with the type of *Trionyx vagans* Cope; and therefore on Bijou Creek, in deposits believed by Whitman Cross to belong to the Arapahoe formation. Professor Hatcher, as cited above, thought that the type locality was doubtful, because Cope, in his latest description (Vert. Cret. Form. West, p. 94) says that the species was "established on a costal bone in association with the preceding species," and the "preceding species" there is *Plastomenus costatus*, of the Judith River beds of British America. This comes from Cope's having transferred without change his original description, which was preceded by his *Trionyx vagans*, to his monograph, where it was preceded by *Plastomenus costatus*. There can be no doubt whatever that the present species was found on Bijou Creek, Colorado. The type is accompanied by a label in Cope's handwriting as follows: "*Plastomenus punctulatus*, 10-9-1873, Colorado." Cope states that he had examined several fragments of the same species that had been collected by Dr. Hayden at Long Lake, in the present state of North Dakota; but at present we can not depend on the determination.

No additional material having been discovered, we can do little more than reprint Cope's description:

Established on a costal bone found in association with the preceding species, and referred to the genus *Plastomenus* provisionally, and with a probability that it will be found not to pertain to it when fully known. That genus has so far only been found in the Eocene formation. The bone is rather thin and sufficiently curved to indicate a convex carapace of moderate thickness. The surface is marked with closely packed shallow pits without material variation of form on the proximal end of the bone. The result is an obsolete sculpture quite similar to that seen in some species of the genus to which it is at present referred.

MEASUREMENTS.

	Meter.
Width of costal bone	0.0230
Thickness of costal bone	.0033

Number of pits in 0.010 meter, 6.

Lignite Cretaceous of Colorado; also several fragments from Long Lake, Nebraska, from Dr. Hayden.

It will be observed that the pits of this carapace are small, and measurements made on the specimen show that there are sometimes seven pits in a line 10 mm. long. The thickness of the bone at the neural border is nearly 5 mm.; thru the swelling caused by the rib on the under side, it is 5 mm. Cope's measurement was taken at the sutural border.

The type locality being known, it does not appear necessary to despair of finding and identifying other specimens of this trionychid.

It is possible that this species belongs to the genus *Plastomenus*, but of this we can not be assured before additional carapacial materials shall have been found accompanied by the plastron.

Plastomenus? insignis Cope.

Plastomenus? insignis, COPE, Ann. Report U. S. Geol. and Geog. Surv. Terrs., 1873 (1874), pp. 433, 454; Bull. U. S. Geol. and Geog. Surv. Terrs., 1, No. 2, 1874, p. 29; Vert. Cret. Form. West, 1875, pp. 95, 261, plate vi, fig. 10.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.—HATCHER, Bull. U. S. Geol. Surv. No. 257, 1905, p. 75.

This species was based on a single fragment of the hypoplastron, presenting a part of the free border of the hinder lobe close to the inguinal notch. This type belongs to the American Museum of Natural History and has the number 1846. It is accompanied by a label in Cope's handwriting as follows: "*Plastomenus insignis*. 10-9-1873, Colorado." In his description Cope states that this specimen was found in the same locality as his *P. punctulatus;* and as shown under the latter species, page 468, this locality was somewhere on Bijou Creek, Colorado. The formation is believed to be the Arapahoe. Professor Hatcher regarded the type locality as doubtful, and this species as therefore worthless from a biological and a stratigraphical point of view. There can be no doubt about the type locality, and the present writer believes that it will be possible to identify other materials coming from this locality and having the same part present.

The fragment has a length of 23 mm. and a width of 11.5 mm. It extends forward to the suture with the hyoplastron and backward nearly, if not actually, to the suture with the xiphiplastron. The acute free border of the bone extends forward within 10 mm. of the hyohypoplastral suture. This fact shows that the species must have been a small one, perhaps not more than 150 mm. long. At the suture with the hyoplastron the bone is 4 mm. thick.

Cope states that the suture with the xiphiplastron was gomphosial. At the hinder end of the bone there is a smooth pit which may have received a process from the xiphiplastron. The writer can not convince himself that any other part of the suture is present. There is no excavation of the free border for a forwardly directed process of the xiphiplastron, such as we might have expected.

The specimen affords no characters that confirm or that refute the reference of the species to the genus *Plastomenus*.

Plastomenus acupictus Hay.

Fig. 629.

Plastomenus acupictus, Hay, Bull. Amer. Mus. Nat. Hist., xxiii, 1907, p. 852, plate liv, figs 1–3; text-fig. 8.

The fragmentary remains of this species are a part of the Cope collection in the American Museum of Natural History. The catalog number is 1025. The bones were collected for Professor Cope many years ago, apparently from Torrejon deposits, in New Mexico, by Mr. David Baldwin. The individual was a small one.

Fig. 629.—*Plastomenus acupictus*. Plastron of type. ×1.

A costal bone, believed to be the third, is 10 mm. wide and 3 mm. thick at the neural border. The seventh costal is 16 mm. wide at the distal end, 3 mm. thick at the sutural edge, and 4.5 mm. thru the ridge formed by the rib.

On the hinder costals are seen 6 or 7 welts. The pits covering all the upper surface except the beveled free border, are unusually small, there being 5 in a line 5 mm. long.

The hinder lobe had a width of about 60 mm. at the base. The suture between the hypoplastron and the xiphiplastron (fig. 629) is 27 mm. long. At the bridge the hypoplastron is 8 mm. wide and 5 mm. thick. As in other species of the genus, there seem to have been no fontanels on the midline of the plastron.

There are no welts on the plastral bones and the pits are somewhat smaller than on the carapace.

Plastomenus catenatus Cope.

Plate 86, fig. 1.

Plastomenus catenatus, Cope, Syst. Cat. Vert. Eocene New Mexico, p. 35; Ann. Report Chief Engineers, 1875, Append. ll, p. 1016 (of reprints, p. 96).

Plastomenus multifoveatus, Cope, Wheeler's Report Surv. West 100th Merid., 1877, iv, p. 49, plate xxv, fig. 11.

The fragment of costal plate on which Cope based the present species is in the U. S. National Museum and bears the number 1138. It was discovered in the Wasatch Eocene beds, in the region of the Gallinas River, New Mexico. When Cope came to figure the specimen, in 1877, he had come to the conclusion that it belonged to a species that he had already described from the Bridger beds of Wyoming, a species which he called *P. multifoveatus*, but which is here described as *P. thomasi*. The present writer has examined the type of *P. catenatus* and has become convinct that it belonged to a species distinct from the Bridger form mentioned. As the fragment has already been named, figured, and described, it appears to be best to retain for it the original name and await the finding of additional materials from the type locality. Cope's figure of the fragment is reproduced on plate 86, fig. 1.

The piece of costal is 25 mm. wide, 4 mm. thick. The ridges separating the pits are wider than in the case of *P. thomasi*, and the slope into the pits is more abrupt. In a line 15 mm. long there are 7 of the pits. In some cases two or more of them appear to have coalesct.

Plastomenus? leptomitus (Cope).

Plate 86, fig. 2; text-fig. 630.

Trionyx leptomitus, Cope, Syst. Cat. Vert. Eocene New Mexico, 1875, p. 35; Append. ll, Ann. Report Chief Engineers, 1875, p. 1015 (*separata*, p. 95); Wheeler's Surv. W. 100th Merid., iv, 1877, p. 44, plate xxv, figs. 27–31, plate xxvi, figs. 1–4.; Vert. Tert. Form. West, 1884, p. 118.—King, U. S. Geol. Explor. 40th Parallel, Syst. Geol., i, 1878, p. 377.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

The known remains of this species were collected by Professor Cope in the year 1874, in deposits belonging to the Wasatch formation, in Rio Arriba County, New Mexico. These specimens are now in the U. S. National Museum, at Washington, and bear the numbers

1110 and 1113, the specimens appearing on Cope's plate xxvi having the latter number. Professor Cope states (Syst. Cat., p. 35) that 4 individuals were represented in his collection. All these, if yet present, are included under the catalog numbers just given. The originals of Cope's figs. 1, 2, and 3, of his plate xxvi, were considered by him to constitute the type of the species, and are said to belong to a single individual. Fig. 1 represents the outer end of the left hypoplastron; fig. 2, apparently a fragment of the left hypoplastron at the bridge; while Cope's fig. 3 is the distal end of a costal. In Cope's fig. 2 the left side represents the sutural border for articulation with the hyoplastron, and the concave edge on the upper right-hand side is the inguinal notch, which is here quite acute. If this identification of the bone is correct, the notch was more abruptly formed than is usual in species of Trionychidæ, and quite as abruptly as in *Plastomenus thomasi*. In order to understand the relations of the bones represented by the two figures, fig. 2 must be conceived as being removed to the left of fig. 1 in such a way that the left edge, the sutural one, shall be turned 90 degrees and placed about parallel with the upper border of fig. 1. When the two figures are thus placed, there should be perhaps about 35 mm. of space between their lower borders. Fig. 630 represents these bones in the position suggested.

The fragment of costal plate represented by Cope's fig. 3, plate xxvi, has a thickness of 10 mm. The figure is reproduced (plate 86, fig. 2). The upper surface is beveled off somewhat and the upper layer of bone overhangs the deeper layers. The upper surface of the bone is sculptured with narrow ridges which run parallel with the free border of the costal. Between these sharp ridges are furrows, which are occasionally divided into pits by intersecting ridges. There are 4 of these furrows in a distance of 10 mm. One fragment of the upper end of a costal is found with the type. It shows the rib-head and was originally about 20 mm. wide. The thickness at the sutural border is 6 mm.; thru the rib it is 7 mm. The angle between the articular border for the corresponding neural and that for the outer hinder angle of the neural next in front shows that the neurals were much wider behind than in front. The upper 25 mm. of the upper surface is covered with large irregular pits, about 3 in 10 mm. Distally they become smaller. It is possible that this fragment does not belong to this species, but other fragments appear to form the transition to the original of Cope's fig. 3, plate xxvi.

FIG. 630.—*Plastomenus leptomitus*. Combination of two of Cope's figures to show their relative positions. ×½. No. 1113 U. S. N. M. Type.

The fragments which belonged to Cope's third specimen, and which furnisht figs. 27 to 31 of his plate xxv, belonged to a larger animal. It is possible, too, that they belonged to a distinct species. As in the type, the costal is thickened distally and the sculpture consists of ridges crossing the costal and connected at intervals by intersecting ridges. In the type of the species the ridges are of nearly uniform size or perhaps they increase slightly in breadth and distance apart toward the free margin of the costal. In the third specimen, however, they are broader and more obtuse and they become distinctly narrower and more crowded toward the margin, as is shown in Cope's figures. Furthermore, the sculptured layer of the type overhangs the deeper layers, at the free margin, more than it does in the originals of Cope's figs. 29–31. All these differences may, however, be due to variations in age and size or to varying positions in the carapace.

In the lot of bones representing this species there is a portion of a plastron, apparently a part of the left hypoplastron from the inguinal region, and hence corresponding to the piece represented by Cope's fig. 2, plate xxvi. This presents a sculpture in which the ridges run at right angles with the hyohypoplastral suture. At this suture the thickness is 8 mm., but nearer the free border it is 15 mm. An outer extremity of a hypoplastron in the lot shows a sculpture different from that of the type individual, and more like that of *Amyda ventricosa*.

More and much better materials are needed in order to determine the structure and relationships of this tortoise. The form of the hypoplastron of the type and to some extent the sculpture of the carapace seem to indicate that the species belongs to, or is near, the genus *Plastomenus*.

Plastomenus? lachrymalis Cope.

Plate 86, fig. 3.

Plastomenus lachrymalis, COPE, Append. FF, Ann. Report Chief of Engineers, 1874, p. 603 (of *separata*, p. 96); Syst. Cat. Vert. Eocene N. Mex., 1875, p. 35; Wheeler's Surv. W. 100th Merid., IV, pt. II, 1877, pp. 48, 51, plate XXV, figs. 7–7*b*; Vert. Tert. Form. West, 1884, p. 123.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.

This insufficiently known species was secured by Cope in the Wasatch deposits of New Mexico. It was based on a single individual and apparently on only fragments of costal plates. Of these 2 were figured. These remains were evidently referred to *Plastomenus* because of the character of the sculpture. We can not be sure of the correctness of this assignment before similar costals shall have been found associated with the plastral bones. The writer does not know where the specimen now is.

Professor Cope's description is given below, and one of his figures, that of the distal end of a costal bone, is reproduced on the plate referred to above. The part of the figure indicated by *a* shows the thickness of the bone.

Costals with finer pits [than in *P. serialis*], the welts broken into tubercles posteriorly.

The largest species of the genus represented in the Eocene of New Mexico. The costal bones are rather finely punctate, the posterior as well as the anterior. The anterior costal bones are crossed by numerous ridges from side to side obliquely; the obliquity increasing posteriorly. On the posterior bones they are broken into vertical bars, separated by considerable intervals, and of linear form. The posterior costals reach a thickness of 0.006 m. and a width of 0.025 m.

The pitting of the posterior part of the carapace distinguishes this species from the *P. œdemius*. But one specimen obtained.

Plastomenus? fractus Cope.

Plate 86, fig. 4.

Plastomenus fractus, COPE, Syst. Cat. Vert. Eocene New Mexico, 1875, p. 35; Append. LL of Wheeler's Report to Chief Engineers, 1875, p. 1016 (of *separata*, p. 96); Wheeler's Surv. W. 100th Merid., IV, pt. ii, 1877, p. 49, plate XXV, figs. 12–19; Vert. Tert. Form. West, 1884, p. 123.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.

The types and all other specimens of this species having apparently been lost, the present writer must content himself with reprinting Cope's description and one of his figures. It may be said, however, that there is nothing about the specimens or the description that either confirms or disproves the correctness of the reference of the species to the genus *Plastomenus*. Important parts of the plastron are needed for the settling of this question. The species comes from the Wasatch beds of New Mexico; but the exact locality was not given by Cope. It was, however, from the region of the Gallinas River.

Five individuals in a fragmentary condition represent this turtle, and present greater uniformity of character than some of the others. The sculpture is a honeycomb, where the fossæ are wider than the separating ridges, [and] which is traversed at intervals of two or three fossæ by elevated lines, which are transverse or oblique to the long axis of the costal bones as they are situated in the carapace. These lines are elevated portions of those separating the fossæ, and hence differ entirely from the smooth, thick welts of the species of the genus which follows. They are usually zigzag in their course, as defining the pits, and sometimes inclose small pits. The vertebral bones are strongly pitted. None of the specimens indicate large size.

MEASUREMENTS.

	Meter.
Width of a vertebral bone	0.012
Width of a costal bone	.022
Thickness of same	.005
Interval between two raised lines	.007

Plate 86, fig. 4, is reproduced from Cope's work of 1877, cited above. The figs. *w* and *x* represent the outer and the inner surfaces of the proximal end of a costal. Figs. *y* and *z* show middle parts of costals. It is greatly to be desired that far better specimens of this and other Wasatch species of turtles, so often based on fragmentary specimens, shall soon be found.

Plastomenus corrugatus Cope.

Plate 86, fig. 5.

Plastomenus corrugatus, COPE, Syst. Cat. Vert. Eocene New Mexico, 1875, p. 35; Append. LL of Wheeler's Report to Chief of Engineers, 1875, p. 1016 (of *separata*, p. 96); Wheeler's Surv. W. 100th Merid., IV, pt. II, 1877, pp. 48, 50, plate XXV, figs. 20–26; Vert. Tert. Form. West, 1884, p. 123.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.

Professor Cope stated in his monograph on the fossil vertebrates of New Mexico that he had remains of 6 individuals which he referred provisionally to the present species. Of these he figured fragments of 2. One of these two was represented by only a portion of the left hypoplastron; and this was regarded as the type of the species. It is represented by his fig. 20, which is here reproduced (plate 86, fig. 5). The other bones figured were portions of costals except the one represented by his figure 25. The present writer is not aware where these figured specimens now are. They were collected in the Wasatch beds of New Mexico. The exact locality was not designated, but it was doubtless from the Gallinas River region.

Of the type bone, the hypoplastral, Cope makes the following statements:

> This bone is ornamented with sharp, raised, narrow ridges, which are straight or vermiculate, and which inosculate but little. The broken base of the bridge is particularly stout, and the thickening continues within the inguinal border to the postabdominal extremity. The inguinal edge is thinner, and is incurved at the postabdominal gomphosis.

MEASUREMENTS.

	Meter.
Thickness of the hyposternal at middle	0.007
Thickness of hyposternal at bridge	.009
Seven ridges measure	.010

Judging from Cope's figures of the costal bones, they presented a very different style of ornamentation. Here we find what Cope has called a honeycombed structure. There were apparently abruptly sunken pits, about 5 in a line 10 mm. long; while the intervening ridges were about as wide as the pits themselves. Professor Cope presented no measurements of these bones, so that we do not know their thickness. Altho they are so different in their style of ornamentation from the type plastral bone they appear to be connected with it by the bone represented by Cope's fig. 25. Cope regarded this bone as a part of the left hyoplastron; but a comparison of it with the plastron of *Plastomenus thomasi* makes it more probably the outer end of the right hyoplastron. The figure ought to be inverted.

Plastomenus communis Cope.

Plate 86, figs. 6–8.

Plastomenus communis, COPE, Syst. Cat. Vert. Eocene, New Mexico, 1875, p. 35; Append. LL of Wheeler's Report to Chief of Engineers, 1875, p. 1016 (of *separata*, p. 96); Wheeler's Surv. West 100th Merid., IV, pt. II, 1877, pp. 48, 50, plate XXV, figs. 1–3, ?4; Vert. Tert. Form. West. 1884, pp. 123, 126.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.

That specimen which is represented by fig. 1, plate XXV, of Cope's memoir publisht in the fourth volume of the Wheeler Survey, must be regarded as the type of the present species. This type belongs to the U. S. National Museum and bears the catalog number 1132. It consists of the distal ends of a number of costal plates and a portion of the left hyoplastron. These were collected by Professor Cope in Wasatch beds in New Mexico, doubtless in the region of the Gallinas River.

While the known remains of this turtle indicate a distinct species and one which may be recognized when other considerable parts shall have been discovered, they do not enable us to obtain an accurate idea of the animal. It must have attained a considerable size, since one of the costals had a width of 44 mm. It had a thick and coarsely sculptured shell (plate 86, figs. 6, 7). There were no rib-ends protruding beyond the borders of the carapace. The form of the fragment of the hyoplastron (plate 86, fig. 8) present indicates pretty certainly that the species belongs to the genus *Plastomenus*.

The free borders of the costals are thick and obtuse, resembling the edge of one's little finger (plate 86, fig. 6*b*). That costal which forms the lower part of fig. 6 here presented has a thickness of 12 mm. The upper surface of the costals is ornamented with pits, of which there are about 4 in a line 10 mm. long, being somewhat larger than stated by Cope. On what are evidently posterior costals there are conspicuous welts, which, at the distal ends of the costals, run parallel with the sutural borders. The pits are in rows parallel with the free borders of the costals.

The portion of the hypoplastron belonging to the type agrees closely in form with that of *P. thomasi*. Cope's figure is reproduced on page 86, fig. 8. The lower border joined the hypoplastron. The lower half of the border on the left joined the hyoplastron of the opposite side. The oblique border above this formed a part of the boundary of a fontanel. The lower surface, as seen, was sculptured with pits, arranged in rows parallel with the mesial border. These pits are smaller than those of the carapace, there being about 6 or 7 of them in a 10 mm. line.

In his description given in the Wheeler Survey Cope includes some fragments in this species that he afterwards (Vert. Tert. Form. West, p. 125) referred to *P. molopinus*, the type of which came from the Bridger beds. While these specimens quite certainly do not belong to *P. communis*, it is doubtful if they belong to *P. molopinus*. It is to be noted that in the text of the Wheeler Survey Cope refers to these specimens as representing a "var. ii," but in the explanation of his plate xxv he speaks of them as "var. i."

Plastomenus thomasi Cope.

Text-figs. 633–637.

Trionyx thomasii, Cope, 1872, Proc. Amer. Philos. Soc., xii, p. 462.

Plastomenus thomasii, Cope, Proc. Acad. Nat. Sci. Phila. 1873, p. 278 (name only); 6th Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 618; Ann. Report Chief Engineers, 1875, Append. ll, p. 1016 (of reprint, p. 96.)—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 453.

Plastomenus multifoveatus, Cope, 1873, Proc. Acad. Nat. Sci. Phila. p. 278 (name only); 6th Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 619; Vert. Tert. Form. West, 1884, pp. 123, 125, plate xviii, figs. 2–8.

The original description of the present species was extremely brief; and we could only with difficulty know that it applied to the species, had not Professor Cope quoted it in subsequent and more detailed descriptions. Only portions of the carapace were mentioned. What appears to be the next reference to the species, that in the Proceedings of the Philadelphia Academy, was accompanied by no characters to distinguish it from related species. With it was mentioned another species called *P. multifoveatus*. It was in this communication that the genus *Plastomenus* was proposed, the characters of which were based on both carapace and plastron. In Hayden's Report for 1872, as cited above, there appear descriptions of both *P. thomasi* and *P. multifoveatus*. With the former were briefly described some plastral bones. In the fourth volume of the Wheeler Survey, Professor Cope described New Mexican specimens which he regarded as belonging to *P. multifoveatus*. To this species he now refers the specimens which he had originally called *P. thomasi*, while the latter name is restricted to plastral bones which he states were more like those of *Trionyx*. In the Vertebrata of the Tertiary Formation of the West, 1884, he writes as follows under *P. multifoveatus*:

> When I stated there [Report Geol. Surv. 1872] that *P. thomasii* is the type of the genus *Plastomenus* I referred to these specimens; it is therefore to be observed that the type of the genus is really the *P. multifoveatus*. The true *P. thomasii* was founded on sternal bones perhaps of a small species of *Trionyx*.

Regarding this statement the following may be said: (1) No plastral bones were mentioned in the original description of *P. thomasi*. (2) The description of *P. thomasi* found in the Hayden Survey report of 1872 was taken bodily into the description of 1884. (3) We know of no description of the plastral bones on which Cope says that *P. thomasi* was founded. In view of these facts we must say that whatever Cope had in mind, he did not, according to the recognized rules of nomenclature, attach the name *P. thomasi* to the Trionyx-like plastral bones, but did attach it to those specimens which he afterward called *P. multifoveatus*. The latter name therefore becomes a synonym of the former.

The bones of the plastron which Professor Cope was disposed to take as the type of *P. thomasi* are now in the American Museum of Natural History, and are described under *Platypeltis serialis*.

Those specimens which Professor Cope figured in his great work of 1884 under the name *P. multifoveatus* must be regarded as the type of the present species. Of these specimens that which furnisht fig. 6 of plate xviii is now in the American Museum of Natural History. The others are in the U. S. National Museum at Washington. Of these figures, 2 and 5 represent the distal ends of 2 costals; fig. 3, the outer end of the right hyoplastron; fig. 4 is the left hypoplastron; and fig. 7, the right hypoplastron. Figs. 2 and 5 seem to indicate that the sculpture is irregular, but in the text Cope states that the ribs intervening between the pits tend to connect into ridges running diagonally across the costal bones. These specimens were obtained on Cottonwood Creek.

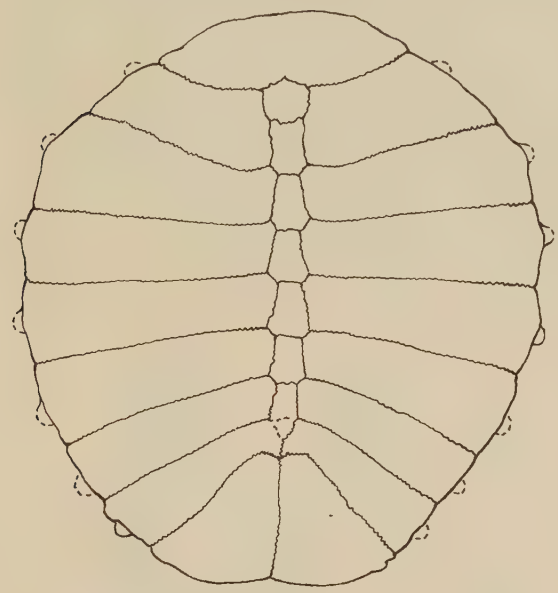


FIG. 631.—*Plastomenus thomasi*. Carapace. ×⅓. No. 6018 A. M. N. H.

The American Museum party of 1903 operating in the Badlands of the Bridger Basin discovered a nearly complete shell which is identified as belonging to Cope's *P. thomasi*. It was found at Grizzly Buttes, and the catalog number of the specimen is 6018. The carapace lacks only unimportant fragments. From the plastron there are missing the entoplastron, the epiplastra, the median end of the right hyoplastron, and the right xiphiplastron.

The carapace (fig. 631) has a length of 218 mm. and a breadth of 210 mm. The upper surface was evidently moderately convex during life. The nuchal bone extends from side to side a distance of 97 mm. and from front to back 30 mm. There are present a preneural and six neurals. It is probable that there was a small seventh neural in a notch between the costals of the seventh pair. The table shows the dimensions of these elements.

Element.	Length.	Width.
Preneural.....	15	17
Neural 1.....	19	15
Neural 2.....	20	14
Neural 3.....	19	15
Neural 4.....	18	14
Neural 5.....	17.5	12
Neural 6.....	14	8

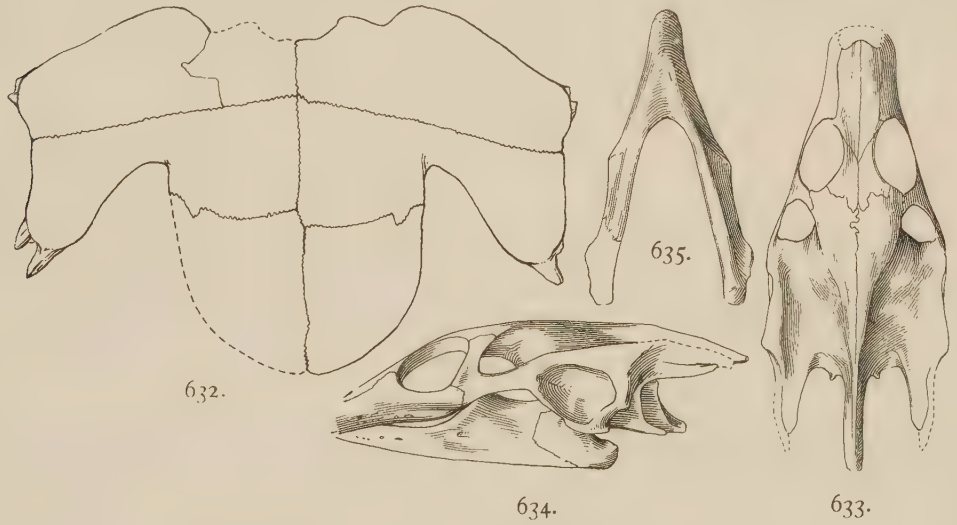
The costals of the eighth pair meet along the midline 48 mm. and each measures 48 mm. along the free border. The outer ends of the ribs extend but little beyond the border of the disk. The outer ends of the costals are about 7 mm. thick; and between the upper and lower layers of the bone there is a channel running around most of the border.

On each side of the upper surface there are seen about 8 low and broad welts; 2 or 3 of these extend on the nuchal. The nuchal and the outer ends of the costals are ornamented with shallow pits. These are mostly arranged in rows parallel with the border of the disk. A line 10 mm. long extends across 4, sometimes 5 pits. On the neurals and the proximal ends of the costals the pits are nearly obsolete.

The form of the plastron and the proportions of its different parts may be seen in fig. 632. The width of the plastron between the ends of the hyohypoplastral suture is 210 mm.; the length along the midline, excluding the missing elements, is 135 mm. The bones of the opposite sides are joined by jagged sutures. The hyohypoplastral suture of each side makes an angle of about 75° with the median longitudinal suture. The greatest width of the hyoplastron is 47 mm.; the width of the midline, 25 mm. The width of the hypoplastron at the midline is 49 mm.; of the xiphiplastron, 60 mm. The width of the hinder lobe, at its base, is 100 mm.; its length is 85 mm. The thickness of the hyoplastron at the midline is 5 mm.;

of the hyoplastron, 7 mm.; of the xiphiplastron, 5 mm. In front of the hyoplastra there was probably a small fontanel, indicated by a notch in each bone. The notch farther from the midline received one end of the entoplastron. The lower surface of all the plastral bones is covered with shallow pits. Most of these are in rows parallel with the free borders of the plastron. There are four, sometimes five, sometimes only three pits in a line 10 mm. long.

Mr. Walter Granger, in 1903, discovered at Grizzly Buttes the skull and the outer end of the left hypoplastron of a trionychid which proves to belong to the present species. Judging from the portion of hypoplastron, the individual was about half-grown. The specific identity of this bone with that of the larger individuals is furnisht by a hypoplastron belonging to the Cope collection, No. 1030 of the American Museum of Natural History. Of the skull (figs. 633–635) practically all portions are represented; but the palatal region has not been cleaned of the matrix. The premaxillary bone is wanting and the occipital condyle is broken away, but the length of the skull from the extremity of the one of these bones to the other has been close to 50 mm. From the snout to the end of the supraoccipital process has been 57 mm. The head is narrow, 24.5 mm. wide, slightly less than one-half the length to the occipital condyle. The snout is long and narrow. The upper surface of the skull forms a regular



FIGS. 632–635.—*Plastomenus thomasi.* Plastron and skull.

632. Plastron. ×⅓. No. 6018 A. M. N. H.
633. Skull, upper view. ×1. No. 6015 A. M. N. H.
634. Skull, side view. ×1. No. 6015 A. M. N. H.
635. Lower jaw, from below. ×1. No. 6015 A. M. N. H.

curve from the snout to the end of the supraoccipital process. The orbit has an antero-posterior diameter of 10 mm., and the space between this and the nostril was the same. No postfrontal bone has been discerned. The postorbital process of the jugal reaches the parietal and this bone enters into the formation of the orbit, a very unusual arrangement. In *Platypeltis spinifera* the postfrontal bone is small, but it excludes the parietal from the orbit. In *Plastomenus thomasi* the interorbital space has a width of 4 mm. The squamosal process was formed as in *Platypeltis*. The lower jaw (fig. 635) is narrowed in front; the symphysis is 14 mm. long.

The respects in which this species differs from *P. visendus*, referred in a former publication to *P. thomasi*, will be given under *P. visendus*.

Plastomenus visendus sp. nov.

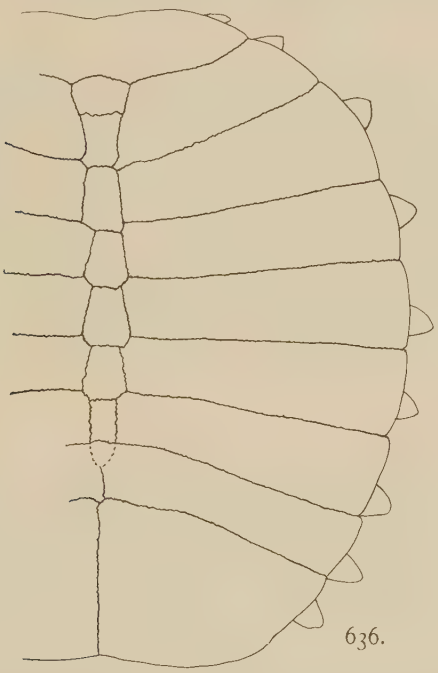
Plate 87, figs. 1, 2; text-figs, 636, 637.

Plastomenus thomasii, HAY, Amer. Geologist, XXXV, 1906, p. 334, figure.

Among the materials included in the Cope collection now in the American Museum of Natural History there was found a cigar-box of fragments which had been collected in the Bridger deposits of the Rattlesnake Hills, Wyoming, in 1895, by Mr. Stanley Stuart. On being fitted together these fragments furnisht a nearly complete carapace and plastron of a

species of *Plastomenus*. It was originally supposed that this was Cope's *P. thomasi*, but the fortunate discovery of a specimen of the latter at Grizzly Buttes, near the type locality, shows that the specimen from the Rattlesnake Hills belongs to a distinct and hitherto undescribed species. The catalog number of the specimen is 1895.

In form this species is broadly oval, with the broadest portion somewhat in front of the middle of the carapace. The latter appears to have been only moderately archt. The total length of the carapace (plate 87, fig. 1; text-fig. 636) is 207 mm. along the midline. The greatest width is 204 mm. There were no fontanels in the carapace, and the ribs extended beyond the disk probably nowhere more than about 12 mm. There is no evidence that there were any peripheral bones. The nuchal is firmly united with the first pair of costals. Only a fragment of the preneural is preserved. There are present remains of 4 neurals. Of the first there is only a fragment. The fifth and sixth neurals are missing. The costals of the seventh and eighth pairs meet in the midline for their whole breadth; hence corresponding neurals



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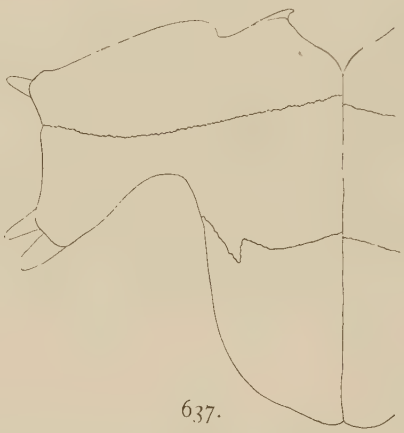


637.

FIGS. 636 AND 637.—*Plastomenus visendus*. $\times \frac{1}{4}$.

636. Carapace. 637. Plastron.

were not developt. The nuchal has a lateral extent of 90 mm.; and a fore-and-aft extent of 20 mm. Its outer ends neither overlap nor underlap the anterior border of the first costals. These costals are somewhat narrower at their distal ends than at the proximal. The other costals, except the seventh, are wider at the outer ends than proximally. The seventh costals are much wider along the midline than any of the others, and form a large part of the rear of the shell. They extend along the midline a distance of 50 mm., and laterally from the midline a distance of 75 mm. The edges of the carapace are rounded or cut off rather abruptly. The thickness of the costals at the free edges is about 5 mm. The only neural which is complete is the third. It has a length of 18 mm. and a width of 12 mm. posteriorly.

The ornamentation consists of a number of longitudinal welts and of numerous pits. Of the welts there are about 10 on each side. These resemble a series of waves, those near the midline being somewhat nearer together than those near the borders of the carapace. On the hindermost costals the welts are sharper and somewhat broken up into elongated nodules. On the nuchal and costals of the first pair the welts are obsolete. The pits are rather shallow and are separated by ridges which are rounded or flat on their summits. There are 5 or 6 of the pits in a line 10 mm. long. They are less distinct on the neurals and the proximal ends of the costals. On the outer halves of most of the costals the pits are arranged to a great extent in rows, parallel with the axis of the animal or with the adjacent free border of the carapace.

Of the plastron (plate 87, fig. 2; text-fig. 637) the entoplastron, both epiplastra, and a small portion of the left hypoplastron are missing. The parts present are shown on the plate

cited. As will be observed, there was a median fontanel partly inclosed by the hyoplastrals. Behind this the elements of the plastron met along the midline to the hinder extremity of the xiphiplastrals, just as in *Chrysemys*. While the hypoplastra join the xiphiplastra by digitations near the outer borders of these bones, these digitations are more feeble than in most trionychids. The digitations reaching from one xiphiplastron to the other are hardly discernible. At the outer ends of the hyoplastron and of the hypoplastron the space between the outwardly projecting processes is more nearly filled up than usual in trionychids. Everywhere the distinction between the bone of the "callosities" and that forming the framework of the plastron is less obvious than in ordinary trionychids.

The length of the plastron, from the line joining the antero-interior angles of the hyoplastra to the hinder border of the xiphiplastra, is 133 mm. Of this distance the union of the hyoplastra occupies about 10 mm., that of the hypoplastra 45 mm., that of the xiphiplastra 92 mm. The greatest width of the hyoplastron is 33 mm. From the extremity of one postero-external process of the hypoplastron to the other is 210 mm. The width of the posterior lobe of the plastron at its base is 108 mm. The width of the bridge is 48 mm., of which the hyoplastron occupies 33 mm.

On the plastron there are no welts, such as appear on the carapace. The pits are not to be distinguisht from those of the upper part of the shell. They are largest and deepest on the outer end of each hypoplastron. They are often arranged in rows which are parallel with the nearest border of the bone. These rows of pits are most conspicuous on the hyoplastron.

This species differs from *P. thomasi* in several particulars. Both the nuchal and the hyoplastron have the fore-and-aft width considerably less than in *P. thomasi*. The hinder border of the bridge portion of the hypoplastron makes a larger angle with the midline than in *P. thomasi*, and the pits of the median portions of the bones of the plastron are larger. Especially, the costals of the eighth pair extend farther along the hinder border of the carapace than they do in *P. thomasi*. The front of the carapace of the latter appears to be more pointed than that of the present species.

Plastomenus tantillus sp. nov.

Figs. 638, 639.

The present specific name is applied to a specimen which was found by the writer in the Bridger beds, near the mouth of Cottonwood Creek, Wyoming, in the year 1903. The level is that designated as B. The individual is a small one, with thin and delicate bones, and it was probably a young animal. It has been greatly flattened by pressure, and to this is due the spreading apart of some of the costals at their distal ends. There are present nearly the complete carapace and the greater portion of the plastron. The specimen bears the American Museum's catalog number 5980.

The outline of the carapace (fig. 638) is rather elongated. There was probably a slight excavation in the anterior border of the nuchal. The hinder border is rounded. The length of the carapace is 105 mm.; the width, excluding the extension of the free ends of the ribs, is 90 mm. The rib-ends projected beyond the disk an undetermined distance. The nuchal has a lateral extent of 46 mm.; a fore-and-aft extent of 13 mm. There is a wide band in front and at the ends which is devoid of the enameled and sculptured band. This bone was quite certainly in contact with a preneural, but the latter is not preserved. There are seven neurals, but the hindermost one is very small, having a length of only 2 mm. The other neurals are comparatively broad. Most of them have the usual hexagonal form seen in the Trionychoidea; but the first is 4-sided. The third has a length of a little more than 10 mm., and a width of 9 mm. Both in front of and behind the third, the others are slightly smaller.

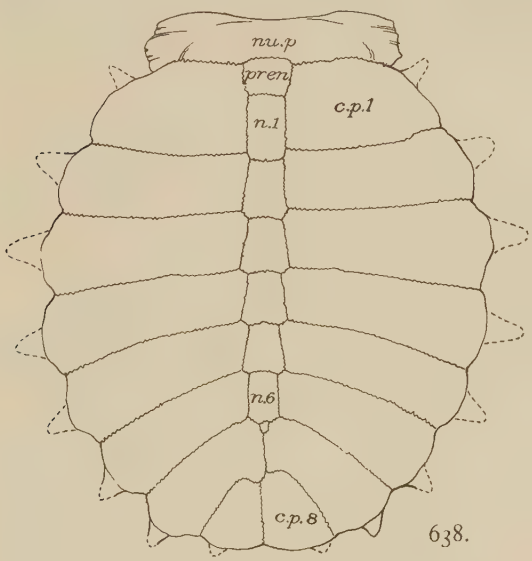
There are 8 pairs of costals. They are thin, the bone having a thickness of only 1.5 mm. at the sutural margins and but little more than 2 mm. where thickest. The rib of each costal occupies about one-half of the whole width of the plate. The first costal has a width of 17 mm. Those of the seventh pair join in the midline. Those of the eighth pair join for their whole length along the midline, a distance of 16 mm.

The ornamentation of the carapace consists of narrow longitudinal welts, shallow pits, and punctæ. There are 5 or 6 low welts on each side of the carapace. The pits are distinct everywhere, except on the neurals and the proximal ends of most of the costals, where they are replaced by the punctæ. Of the pits there are usually 8 in a line 10 mm. long.

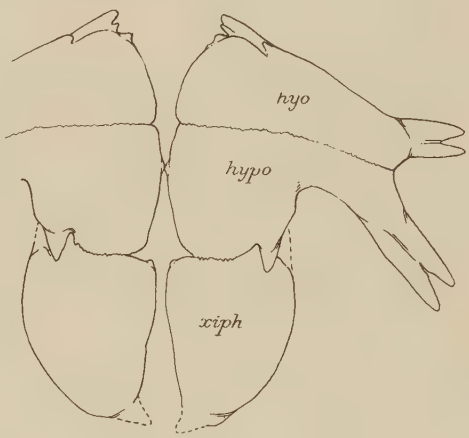
The plastron (fig. 639) resembles in general that of *P. thomasi*, but the bones have not joined so closely along the midline, a condition indicative of youth. The bones average about 2 mm. in thickness. At the inguinal notch the hypoplastron is 4 mm. thick. On a line joining the axillary and inguinal notches, the hypoplastron is nearly as wide as the hyoplastron; but this is quite certainly a feature due to immaturity. The same difference may be noted between the young and the adult of *Platypeltis spinifera*.

The plastral bones are covered with a network of ridges inclosing shallow pits, except on the processes. The pits are like those of the carapace in size and distance apart. They are, to a great extent, arranged in rows parallel with the nearest border of the bone. This is most evident on the xiphiplastra.

This individual differs in various respects from the specimens which are referred to *P. thomasi;* but many of these differences may be due to the immature condition of the animal.



638.



639.

FIGS. 638 AND 639.—*Plastomenus tantillus*. Carapace and plastron of type. $\times \frac{2}{3}$.

638. Carapace. *c.p.* 1, *c.p.* 8, first and eighth costals; *n.* 1, *n.* 6, first and sixth neurals; *nu. p.*, nuchal plate; *pren*, preneural.
639. Plastron. *hyo*, hyoplastron; *hypo*, hypoplastron; *xiph*, xiphiplastron.

The carapace would probably become somewhat broader with age, as the space between the free ends of the ribs became filled up. The anterior costals are relatively broader, fore and aft, than in *P. thomasi*. The eighth costals meet along the midline a distance which is contained in the entire length of the carapace 6.5 times; whereas, in the adult specimens of *P. thomasi*, the length of their union is contained in the entire length only 4.5 times. In the latter species the hinder border is somewhat excavated; in *P. tantillus* it is convex. The sculpture of *P. thomasi* is considerably coarser than that of the species here described; and it is believed by the writer that the coarseness of the sculpture of Trionychoidea changes little, if at all, with increase in size of the individual.

Plastomenus œdemius Cope.

Figs. 640, 641.

Anostira œdemia, COPE, Palæont. Bull. No. 1, July 29, 1872, p. 461; Proc. Amer. Philos. Soc. XII, 1873, p. 461.

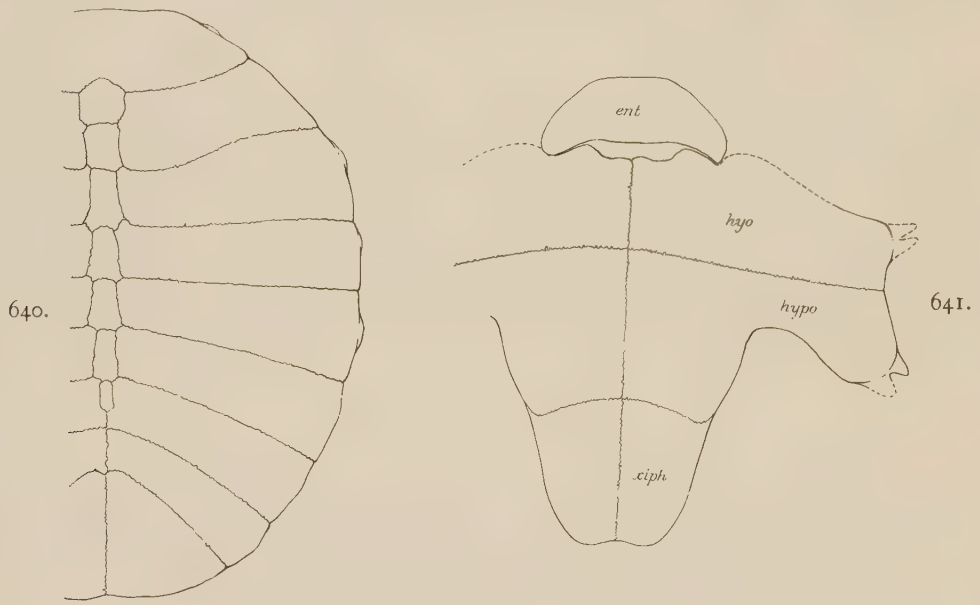
Plastomenus œdemius, COPE, 6th Ann. Rept. U. S. Geol. Surv. Terrs., 1873, p. 619; Proc. Acad. Nat. Sci. Phila. 1873, p. 279; Wheeler's Surv. West. 100th Merid., IV, 1877, p. 48; Vert. Tert. Form. West, 1884, pp. 123, 126, plate XVIII, figs. 15–17.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 453; Amer. Geologist, XXXV, 1905, p. 334.

The type specimens of this species, figured by Cope as cited above, are now a part of the Cope collection in the American Museum of Natural History. With these are other specimens which were collected by Cope, but they are fragmentary and throw little light on the structure

of the species. Some of the specimens mentioned by that author are either not present or have not been recognized. They had all been collected in the Bridger beds of Wyoming. The type came from Cottonwood Creek and therefore from level B, and has the American Museum's number 3937,

In the year 1903 the American Museum of Natural History sent a party into the Eocene Badlands in the region of Fort Bridger, Wyoming. Among the materials collected by this party is a nearly complete carapace and a fragmentary plastron, which are believed to belong to the above species. These parts are represented by figs. 640 and 641. The specimen bears the catalog number 5978.

In form the carapace is oval, or elliptical, narrowed in front, rounded behind. It is considerably archt, the midline rising to a height of 73 mm. above the borders. The length is 310 mm.; the width, 270 mm. The carapace (fig. 640) consists of a nuchal, 8 pairs of costals, a preneural, and 6 neurals. The nuchal has a length of 145 mm. and a fore-and-aft width of



FIGS. 640 AND 641.—*Plastomenus ædemius*. Carapace and plastron. $\times\frac{1}{4}$. No. 5978 A. M. N. H.

640. Carapace. 641. Plastron.

38 mm. along the midline. Its hinder border is somewhat excavated for the preneural. The costals widen toward their distal ends. The free border of each is beveled. The free ends of the ribs are very short. The thickness of the costals is about 5 mm. Those of the sixth pair inclose between their proximal ends the sixth neural; but behind this they join in the midline. The costals of the seventh and eighth pairs also meet in the midline, the former for a distance of 20 mm., the latter for a distance of 65 mm.

The preneural is pentagonal, 24 mm. long, and of about the same width. The first neural is pentagonal, 25 mm. long and 19 mm. wide. The right postero-lateral side is very short, and articulates with the second right costal. The third neural is four-sided, 34 mm. long and 16 mm. wide. The next 3 neurals are hexagonal, with the narrow end forward. The fifth is 13 mm. wide. The last neural is small, 15 mm. long and 6 mm. wide.

The sculpture of the surface consists of longitudinal ridges, or welts, and shallow pits. Neither the welts nor the pits are conspicuous. The welts are obsolete on the anterior half of the carapace, most distinct posteriorly. Running longitudinally as they do, they cross the costals of the middle of the carapace at right angles. Posteriorly they cross the costals obliquely. A close examination of the welts shows that they resemble those of the type of the species. On the last costal they run in the same direction and become resolved into low tubercles, but these are not so swollen as in the type.

The pits are shallow and in many portions of the carapace, especially near the midline and on the rear, they are obsolete. Many of them form what Cope has designated punctæ. They cover the nuchal, the outer halves of the anterior costals, and distal thirds of hinder costals.

A considerable portion of the plastron (fig. 641) is preserved, but it is fragmentary and, in many cases, there is contact between the fragments present. It is believed, however, that the restoration presented by fig. 641 is not far from correct. The specimen has furnisht the entoplastron, a part not hitherto known in the genus.

The length of the plastron, from the front of the entoplastron to the hinder end of the xiphiplastrals, is about 245 mm.; the width about 275 mm. Evidently there were no fontanels in the midline, except a short and wide one just behind the entoplastron. The latter bone is more like that of *Cyclanorbis senegalensis*, as figured by Siebenrock (Sitzber. Akad. Wissensch. Wien, XCI, 1902, p. 34), than like that of any other living species. The lateral branches of the bone made an obtuse angle with each other. The original bones are covered with a thick callosity and this has filled up the angle between them. The bone measures 38 mm. on the midline, and is from 6 mm. to 8 mm. thick.

The hyoplastra meet along the midline a distance of 50 mm.; the hypoplastra, a distance of about 75 mm. The hinder sutural border of the hypoplastron is not present, and the xiphiplastron ought possibly to have been removed somewhat further backward, but certainly not much further. The hyoplastra were flat for a distance of about 60 mm. on each side of the midline; then they have sloped upward and outward. Where the slope begins, the bone is about 12 mm. thick. The outer ends are considerably thinner. The outer end of the hypoplastron is 13 mm. thick, and terminates in 2 processes. The inguinal notch was abrupt.

The hinder portion of the hypoplastron which is shown in the figure preserves the sutural border which joined the bone of the opposite side. It shows therefore the width of that part of the hinder lobe. This was close to 125 mm. The hypoplastron had a thickness of about 12 mm. at the inner border, but thinned toward the free border.

The median and anterior sutural borders of the xiphiplastron have not been preserved, but the bone, both mesially and anteriorly, evidently approaches these sutures closely. The outer, or free, border of the hinder lobe was quite certainly concave at the hypoxiphiplastral suture and convex both in front and behind it. The hinder half of the xiphiplastron has a thickness near the mesial border of 6 mm.; near the free border, 4 mm. The hinder border of the lobe was probably slightly excavated.

The whole lower surface of the plastron, except possibly the epiplastra, which are not known, is sculptured into a network of ridges, which inclose pits of varying sizes and depths. On the entoplastron the pits are irregularly arranged and shallow, and there are 5 or 6 of them in a line 10 mm. long. The median half of the hyoplastron is similarly ornamented, altho toward the suture with the hypoplastron the pits become obsolete. The outer extremity of the hypoplastron is furnisht with large pits, three or four in a line of 10 mm.. That portion of this bone which enters into the hinder lobe has the pits arranged in regular rows which run parallel with the free border of the lobe. Four rows of pits occupy a distance of 10 mm. The xiphiplastra are similarly ornamented, but the pits become somewhat smaller posteriorly and the rows less regular. This specimen was collected in the western portion of Grizzly Buttes. Cope states that two of his specimens came from Cottonwood Creek.

Plastomenus molopinus Cope.

Plate 85, fig. 3; text-fig. 642.

Trionyx, LEIDY, Contrib. Ext. Fauna West. Terrs., 1873, p. 180, plate xvi, figs. 1, 2.

Anostira molopinus, COPE, Palæont. Bull. No. 1, July 29, 1873, p. 461; Proc. Amer. Philos. Soc., XII, 1873, p. 461.

Plastomenus molopinus, COPE, 6th Ann. Rept. U. S. Geol. Surv. Terrs., 1873, p. 6 20; Proc. Acad. Nat. Sci. Phila. 1873, p. 279; Vert. Tert. Form. West, 1884, pp. 123, 125, plate xviii, figs. 9–14.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 452.

Plastomenus communis var. ii, COPE, Wheeler's Surv. W. 100th Merid., 1877, p. 50, pl. xxv, figs. 5, 6.

Professor Cope stated that he possest remains of 8 individuals of this species from the Bridger beds of Wyoming. The specimens figured by him in his Vertebrata of the Tertiary Formations of the West belonged to one individual, and consist wholly of fragmentary costal plates. They are now in the American Museum of Natural History and have the number 6072.

Cope did not clearly distinguish this species from *P. œdemius*. One last costal is indeed mentioned as being crost by longitudinal ridges; and he states that if these had been broken up into tubercles he would have referred the specimen to *P. œdemius*.

In the collection of turtles secured by the American Museum expedition of 1903 there are 2 specimens which the writer refers to *P. molopinus*. These were obtained at Grizzly Buttes, from the level known as B. One of these, No. 5941, presents a practically complete carapace and a few fragments of the plastron; the other, No. 5945, consists of a portion of the carapace and some parts of the plastron. These remains show great resemblances to *P. œdemius*, and it is possible that they should be referred there, and that *P. molopinus* is not different from the former species. There is, however, one difference between the two forms which appears to be constant. This is found in the ornamentation of the outer surfaces. Little if any difference is to be seen in the character of the welts, but the pits, or punctæ, of *P. molopinus* are smaller and closer together than they are in *P. œdemius*. In the latter there are usually only 3 or 4 pits in a space of 10 mm.; while in *P. molopinus* there are quite constantly 6 or 7, occasionally but 5. To the eye, the sculpture of the latter has a much finer appearance. In the case of both species, the longitudinal welts are broken up, on the last costals, into elongated tubercles. It is also to be noted that the pits and punctæ of *P. molopinus* are more generally distributed over the carapace than they are in *P. œdemius*.

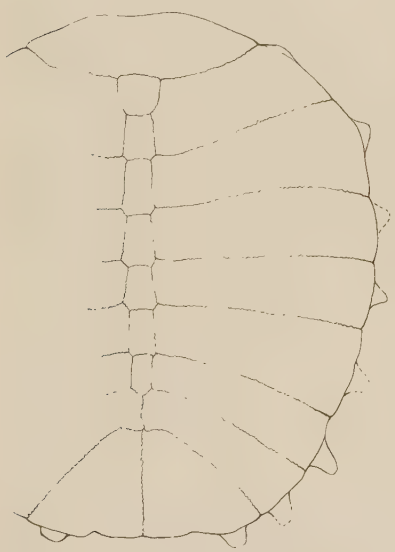


Fig. 642.—*Plastomenus molopinus*. Carapace. $\times\frac{1}{3}$. No. 5941 A.M.N.H.

In *P. œdemius* the neurals, the proximal ends of most of the costals, and the whole of the hindermost costals, are smooth or nearly so, except where varied by the presence of welts.

The sculpture on No. 5941 is not very distinct, a fact that is due principally to the dirty color of the specimen. No. 5945 is of a clear sage-green and has been weathered free from all matrix. It shows the welts and the punctæ with great distinctness.

No. 5941 (plate 85, fig. 3; text-fig. 642) has a length of 200 mm. and a width of 180 mm. It resembles closely the specimen, No. 5978, which has been described here as *P. œdemius*. It was, in life, evidently quite convex. It differs from *P. œdemius*, as represented by No. 5978, in having the costals of the sixth pair wholly separated by the sixth neural. No. 5945 differs from No. 5978 in the same way; but it differs from No. 5941 in having a minute seventh neural. This neural is regarded as having no specific value. No. 5945 further differs from No. 5941 in the somewhat broader neurals, and in having the free borders of the costals less abruptly beveled.

Of both specimens, No. 5941 and No. 5945, the mesial end of the hyoplastron is present. It differs from the same region in *P. œdemius* in having a notch in the front border, mesiad of the process against which the outer end of the entoplastron rests; but whether or not this might appear with greater age is uncertain. The distal end of the hypoplastron is present in No. 5945. It differs somewhat from that of *P. œdemius*, but it is impossible to say how constant this difference is likely to be.

The sculpture of the plastron differs from that of the plastron of *P. œdemius* in consisting of smaller and more closely placed pits and punctæ. Of course, in making the comparison corresponding regions must be compared.

Both the specimens here referred to *P. molopinus* were secured in the Bridger beds of the western end of Grizzly Buttes. Cope figures specimens from the Wasatch of New Mexico under the name *P. communis*. These are indicated in the text (Wheeler Surv., IV, p. 50) as "var. ii," but in the explanation of plate XXV as "var. i." We must be uncertain about this identification until additional materials of the supposed *molopinus* have been secured in the Wasatch beds.

Family TRIONYCHIDÆ.

Trionychoidea having the carapace devoid of peripheral bones, except in the case of *Trionyx* (*Emyda* Gray), in which the few nodules may be of secondary origin. Epiplastra separated from the hyoplastra by lateral prolongations of the slender, archt or V-shaped entoplastron. More or less extensive fontanels between the hyoplastra, hypoplastra, and xiphiplastra of the two sides. Pelvis not suturally joined to either the carapace or the plastron. So far as known, no epidermal scutes. Only 3 digits with claws.

The Trionychidæ constitute a family of tortoises remarkable on account of their structure, their numbers, their geographical distribution, and their geological history. The oldest forms at present known to us come from the Upper Cretaceous of New Jersey, Wyoming, Montana, and Alberta, British America. It is probably not now possible to determine which deposits are the older, the lower marl beds of New Jersey, which furnish the little known *Amyda prisca* and *A.? halophila*, or the Judith River beds, from which we obtain *Aspideretes coalescens*, *A. foveatus*, and *A. splendidus*. So far as the shells are concerned, we find in the Judith River forms only specific differences when compared with living species. *Aspideretes beecheri*, of the Laramie and probably too of the Judith River beds, furnishes practically all portions of the skeleton, except the skull; and these agree in all essential respects with the skeletons of living trionychids. So far as the writer is aware, the oldest known trionychid skull is that of *Conchochelys admirabilis* Hay of the Puerco deposits. This presents some differences when compared with modern trionychids. The next oldest skull, that of *Aspideretes singularis*, of the Torrejon, differs little from that of *Platypeltus ferox*, now living in Florida.

Trionychids are at present found in Asia, Africa, and North America. Asia furnishes at least 15 species, Africa 5 species, and North America about 7.

All these data point to a very ancient origin for the Trionychidæ. We may expect to find more primitive forms in fresh-water deposits of the Lower Cretaceous or even in those of the Jurassic. It is probable that these primitive forms will approach more closely the Cryptodira than do the Plastomenidæ.

A^1. Skull broad, with narrowed pterygoids and wide maxillary alveolar surfaces..... *Conchochelys*
A^2. Skull unknown; carapace and plastron covered with pustular elevations..... *Helopanoplia*
A^3. Skull usually not so broad; pterygoid region of the palate broad:
  a^1. Plastron smooth; no ridges and pits..... *Axestemys*
  a^2. Carapace and plastron ornamented with ridges and pits.
    1. Eight pairs of costal bones; a preneural present..... *Aspideretes*
    2. Eight pairs of costal bones; no preneural ..... *Amyda*
    3. Seven pairs of costals, or those of the eighth pair vestigial; no preneural.. *Platypeltis*

Genus CONCHOCHELYS Hay.

Skull broad. Masticatory surfaces broad and concave. Pterygoid region narrow. Basioccipital region short. Choanæ behind the orbits. Posterior squamosal process apparently much shortened.

Type: *Conchochelys admirabilis* Hay.

In its broadened form, its narrowed pterygoid region, and in its apparently abbreviated posterior squamosal processes, this trionychid presents such deviations from known genera that the writer is led to the conclusion that it represents a genus distinct from all others hitherto described. Until more shall have been discovered regarding the structure of the animal, the characters given above may serve to distinguish this genus. The name *Conchochelys*, given in reference to the supposed nature of the food of the turtle, was first publisht in the Bulletin of the American Museum of Natural History, vol. xxi, 1905, page 335.

Conchochelys admirabilis Hay.

Plate 88, figs. 1–3.

Conchochelys admirabilis, Hay, Bull. Amer. Mus. Nat. Hist. xxi, 1905, pp. 335–338, figs. 1–3.

The skull which is here described was collected in the year 1892 by Mr. O. A. Peterson, who accompanied Dr. J. L. Wortman, then in charge of a collecting party from the American Museum of Natural History. It was obtained in the Puerco beds of the northern part of New

Mexico. The exact locality is Coal Creek Canyon, in the southeastern corner of San Juan County. The specimen bears the catalog number 6090. The skull is quite complete, with the exception of the absence of the lower jaw. Figures of the object as seen from above, from below and from the right side are presented.

The skull is that of a large and evidently aged individual and no sutures are to be observed.

The premaxilla and the anterior extremities of the maxillæ are missing, but the missing parts would add little to the length of the snout. The distance from the front of the nasal bones to the extremity of the occipital condyle is 127 mm. The breadth across the zygomatic arches is 111 mm.; the distance from the outside of one quadrate to that of the other appears to have been about 88 mm.; and the width across the skull at the middle of the tympanic cavities is 108 mm. It will be seen therefore that the roof of the tympanic cavity projects much over the pedicels of the quadrates. Usually in living trionychids the breadth across the pedicels of the quadrates is as great, or nearly as great, as the breadth at any other part. The hinder portion of the skull is shortened. The extremity of the condyle is only 13 mm. behind the line joining the quadrates. In a specimen of *Platypeltis ferox* 94 mm. long from the snout to the condyle, the latter is placed at a distance of 17 mm. behind the quadrates. Relatively to other species of the group the skull is broad, the breadth being 86 per cent. of the length. In *Pelochelys cantoris*, whose skull is relatively broad, the width of the latter is 82 per cent. of the length. The skull of the species under description is flat, and this appears to be due in no measure to crushing. Placed on a level surface, the skull has its crest elevated to a height of 65 mm. The snout was blunt. The skull maintains its breadth as far forward as the line joining the posterior borders of the orbits, where it is 98 mm.; then the outlines converge rapidly. The interorbital space is 15 mm. wide. The orbits look outward, forward, and upward, and are circular, with diameters of 22 mm. From the orbits the sides of the face slope downward and outward.

The anterior nasal opening appears to have had little height, rising only 8 mm. above the floor of the passage. Its breadth has been 20 mm. The lateral crests of the parietals converge rapidly and meet opposite the fronts of the prootics. The postorbital arch has a width of 11 mm; the zygomatic arch a width of only 8 mm. in the middle of its length. At its anterior inferior border it starts from the hinder extremity of the cutting-edge of the maxilla, and ascending passes backward to the front of the tympanic cavity. It is far more archt than that of living trionychids. The tympanic cavity is relatively longer than that of *Platypeltis ferox*, the length being 33 mm., one-fourth the length of the skull. In *ferox* the length of the cavity is about one-fifth the length of the skull.

In contradistinction to *P. ferox*, the upper border of the squamosal is not rolled downward, but stands out as a sharp edge. Moreover, there does not appear to have existed that long backwardly directed process of the squamosal and paroccipital which we find so conspicuous in the living trionychids. It is possible that this process was originally somewhat longer than now appears; but it could have been but little longer.

The fossa inclosed by the zygomatic arch is greatly different from that of *Platypeltis*. In the latter, and perhaps in all living members of the Trionychidæ, the fossa is longer than broad. In this Puerco species the length is 34 mm., the width about 38 mm.

The occipital crest has been injured and is partly missing. It included a lower horizontally expanded border and a thickened superior border. The latter may be, so far as preserved, the backwardly prolonged parietals.

The upper jaws were furnisht with subacute cutting-edges. From these the palate rises in a high vault, 26 mm. above the cutting-edges. The choanæ are removed far backward, their front borders touching a perpendicular plane thru the posterior borders of the orbits. The distance from the premaxillæ to these choanæ was about 50 mm. There was, therefore, an enormous crushing surface on the upper jaws, and we may conclude with safety that the animal was accustomed to devouring a prey that was protected by hard coverings, such as mollusks. From each choana a groove in the roof of the mouth extends backward about 30 mm.

The pterygoid region is only 36 mm. wide. In the specimen of *Platypeltis ferox* referred to, the pterygoid region is eight-tenths the width of the upper jaws. This region in the fossil is very concave transversely. The articulation of the quadrate was about 20 mm. wide.

This skull is the most ancient one of the Trionychidæ that is at present known.

Genus HELOPANOPLIA nov.

Trionychids with hyoplastron and hypoplastron not co-ossified, and with both the carapace and the plastron ornamented with numerous tubercles which resemble the rounded heads of small nails. The tubercles in some places coalescing to form short ridges.

Derivation of name: ἦλος, a nail used for ornament; πανοπλία, full armor.

Type: *Helopanoplia distincta* Hay.

This genus differs from *Trionyx* (*Emyda* Gray) in having the hyoplastron free from the hypoplastron until advanced age. In *Trionyx* the two bones co-ossify at a very early stage. Doubtless better materials of the fossil species will reveal other differences.

Helopanoplia distincta sp. nov.

Plate 88, figs. 4, 5.

The only known materials which indicate the former existence of this species are a fragment of one costal plate and a portion of one hypoplastron or hyoplastron. These fragments were collected by Prof. J. B. Hatcher, while in the employ of Prof. O. C. Marsh, at that time vertebrate paleontologist of the U. S. Geological Survey. The remains were secured in the Laramie deposits of Lance Creek, Converse County, Wyoming, and indicate a rather large and heavy soft-shelled tortoise. The fragment of carapace (plate 88, fig. 4) is a part of the upper half of a costal plate. It is only 34 mm. long and does not extend entirely across the plate, but apparently lacks little of doing so, since the thickening of the rib lies rather closer to the side bearing the suture than to the other. The thickness thru the sutural border is 10 mm.; thru the rib, 13.5 mm. at the proximal end of the bone, and 10.5 mm. at the distal end.

Whether the fragment of the plastron (plate 88, fig. 5) belongs to the hyoplastron or to the hypoplastron can not be determined with certainty; it seems to belong to the latter of the left side. The piece formed a portion of the plastron between the fore and hind legs. The bone is thickened most at the end farthest from the midline, being there 15 mm. Toward the midline the thickness becomes reduced to 9 mm. At the free border the bone is suddenly reduced in thickness and the edge is subacute.

The ornamentation of this species resembles much that of *Trionyx granosus*, called *Emyda granosa*, in Boulenger's Catalogue of Chelonians. The costal plate is thickly studded with small, rounded tubercles which look like the heads of insect pins. Four or five of these occupy a distance of 5 mm. The distance between the tubercles is, on an average, somewhat less than the diameters of the tubercles themselves. Perhaps half of the tubercles become connected in twos and threes to form short and winding ridges. Similarly, but to a greater extent, the tubercles of *Trionyx granosus* coalesce along the middle of the back.

On the piece of plastron the tubercles are less crowded and seldom join to form ridges.

It is believed that this style of ornamentation is so different from that of the other species of Trionychidæ that a distinct genus is indicated.

Genus ASPIDERETES Hay.

Carapace with 8 pairs of costal plates; one or more of the posterior pairs in contact on the midline. A preneural plate between the nuchal and the true first neural. Young of living species with numerous longitudinal dorsal dermal ridges or series of tubercles.

The type of this genus is *Trionyx gangeticus* of Cuvier. Other living species are *A. hurum* and *A. leithii*. *Trionyx melitensis* described by Dr. Lydekker from the Miocene of Malta must be referred to the same genus.

That which distinguishes this genus from *Amyda* is the presence of a preneural bone. The writer regards this as a primitive character which has been lost by the other genera of Trionychidæ. This bone is present in the Plastomenidæ also and in some of the Baënidæ.

It is a noteworthy fact that no trionychid from the Cretaceous deposits is known to be without this bone. Two Upper Cretaceous species are arranged under *Amyda*, viz., *A. prisca* and *A. halophila*, but these are based on fragments only and it is quite probable that better materials would show the presence of the preneural.

KEY TO THE SPECIES OF ASPIDERETES.

A^1. Judith River and Laramie species:

1. Shell of moderate size, broad; middle region of carapace with round pits, somewhat scattered; distal ends of costals crossed by furrows and ridges; plastron with twisted ridges ..... *foveatus*
2. Shell large, broader than long; pits numerous everywhere, in rows across distal ends of costals; nuchal excavated in front ..... *coalescens*
3. Shell large, considerably broader than long; sculpture like that of *coalescens*, but less in rows across outer ends of costals; nuchal convex in front, straight behind ..... *splendidus*
4. Shell nearly as broad as long, sculpture of carapace as in *coalescens;* nuchal straight or convex in front, shorter from side to side than *splendidus;* sculpture of plastron finer than in *coalescens* ..... *beecheri*
5. Nuchal with thick abrupt free border; its width equal to half the distance from preneural to outer end; thickness at preneural border of type 4 mm.; pits not large... *fontanus*
6. Nuchal with thick abrupt free border; width probably less than in *A. fontanus* and thickness greater; pits large and irregular in arrangement ..... *austerus*
7. Nuchal three-fifths as wide as distance from preneural to outer end; free border beveled off; bone at preneural border 7 mm. thick, preneural as wide as nuchal.. *vorax*

A^2. Arapahoe species:

A species not well known. Pits of costal bones shallower than in the species numbered 2, 3 and 4, and with less abrupt walls ..... *vagans*

A^3. Fort Union and Puerco species:

1. Disk of carapace longer than wide; nuchal joined by its whole length to preneural and first costals; the outer end hardly reaching the rib of the first costal; 5 to 7 pits in 25 mm. line ..... *sagatus*
2. As in *sagatus*, but the outer end of the nuchal extending across the rib of the first costal; 6 to 8 pits in a 20 mm. line on proximal ends of costals; only 3 or 4 on distal ends ..... *singularis*
3. Disk wider than long; sculpture obscure in known specimen, but finer than in *sagatus* ..... *nassau*
4. Disk longer than wide; nuchal loosely joined to preneural and costals; fontanels behind it ..... *puercensis*

A^4. Bridger species:

1. Preneural doubtfully present; a fontanel on each side of its position. Pits of carapace large ..... *guttatus*
2. A well-developed preneural and no fontanels; sculpture somewhat coarser than in either the preceding or the following species; second and third neurals about half as wide as long ..... *ellipticus*
3. A well-developt preneural and no fontanel; sculpture like that of *guttatus;* second and third neurals nearly two-thirds as wide as long ..... *grangeri*

Aspideretes foveatus (Leidy).

Plate 89, figs. 1, 2; text-figs. 643, 644.

Trionyx foveatus, LEIDY, Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 73, 312; Amer. Jour. Sci., (2) XXII, 1856, p. 120; Trans. Amer. Philos. Soc., XI, 1860, p. 148, plate xi, figs. 1–3.—COPE, Synop. Ext. Bat. Rept. and Aves N. A., in Trans. Amer. Philos. Soc., XIV, 1869, p. 152; Bull. U. S. Geol. and Geog. Surv. Terrs., I, 1879, No. 2, p. 29; Vert. Tert. Form. West, 1875, p. 260; Bull. U. S. Geol. and Geog. Surv. Terrs., 1877, III, p. 573.—LAMBE, 1902, Geol. Surv. Canada, Summary Rept. for 1901, p. 81, plates i, ii; Cont. Canad. Palæont, III (4 to), pt. II, p. 33, plate i, figs. 1, 2, text-fig. 1.—HAY, Bibliog. and Cat. Foss. Vert. N. A., p. 454, 1902.—HATCHER, Bull. U. S. Geol. Surv. No. 257, 1905, p. 72.

The specimens described by Dr. Leidy under the name *Trionyx foveatus* were collected by Dr. F. V. Hayden partly in the Judith River beds of Montana and partly in beds supposed to be of the same age, near Long Lake, in what is now Burleigh County, North Dakota.

Those from the Judith River basin are described as consisting of small fragments of costal and sternal plates; and of these the proximal half of a costal plate and two fragments of a hypoplastron are described and figured in Leidy's paper of 1860 on "The Extinct Vertebrate

Fauna from the Judith River and Great Lignite Formations of Nebraska," publisht as cited above. These parts, now preserved in the Academy of Natural Science at Philadelphia, must be regarded as the types of the species. A fragment of the right last costal plate, found near Long Lake, was identified, with some doubt, as belonging to the same species, and furnisht fig. 3 of Leidy's plate above cited. This specimen is now in the National Museum at Washington and bears the catalog number 990.

As regards the type specimens, there seems to be no certainty that the costal plate and the fragments of plastron were found associated. We must, however, for the present, assume that they belong to the same species. Should future discoveries prove that two species are involved, we shall have to take the costal plate as the type.

This costal is 22 mm. wide, 5 mm. thick at the sutural margins, and 7 mm. thick thru the rib. The ornamentation consists of pits of varying size and shape separated by ridges whose summits are usually flat. There are, in general, 5 pits in a line 10 mm. long. The pits are, as stated by Leidy, smaller at the proximal end of the costal than further outward; but this increase in size is due to the narrowing of the separating walls, not to a reduction in the number of pits in a given line. The pits are concave, and give the impression of having been scoopt by an engraver in a level surface. Near the sutural margins of the costal the pits are almost wholly wanting and the surface is level and smooth.

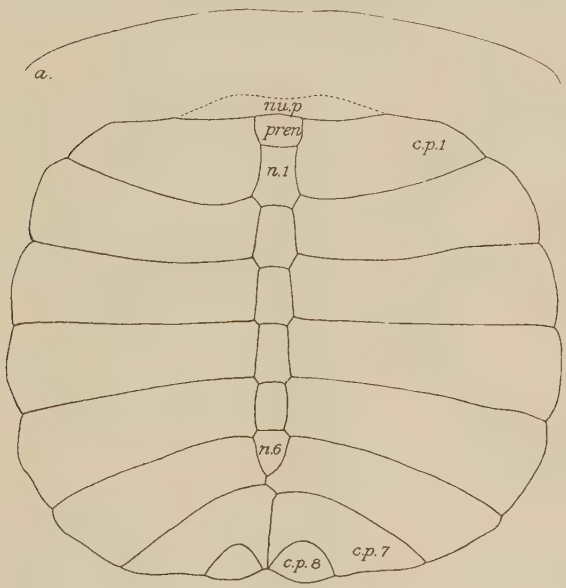


FIG. 643.—*Aspideretes foveatus*. Carapace. ×⅜. Figure by L. M. Lambe.

a, line showing curvature of shell from side to side; *c.p.* 1, *c.p.* 8, the costal bones; *pren*, preneural; *n.* 1, *n.* 6, the neurals; *nu.p*, nuchal bone.

The fragments of the plastron of the type are 8 mm. thick. The lower surface is covered with short vermiculated ridges, some of which inosculate with the neighboring ridges while others do not. Scattered among these are small dot-like elevations.

Mr. L. M. Lambe, of the Geological Survey of Canada, described, as cited in the synonymy above, a nearly complete carapace and some plastral bones which he refers to this species. These he secured in the Belly River deposits, on the Red Deer River, in Alberta, British America. The nuchal bone is missing from the carapace. The length of the carapace (plate 89, fig. 1; text-fig. 643) as found, is 163 mm. The width of the nuchal has been estimated by Lambe as 5 mm. but it is probable that the width fore and aft was considerably greater. The maximum width of the carapace is 214 mm. The rear is broadly rounded, and the upper surface is moderately convex. There are present a preneural, 6 neurals, and 8 pairs of costals. The genus *Aspideretes* is therefore indicated.

Neurals.	Length.	Greatest width.
1	20	18
2	22	16
3	20	14
4	21	13
5	18	11
6	16	14

The preneural is short, being 18 mm. wide and 12 mm. long. The 4 anterior neurals are broader behind than in front; the fifth is a parallelogram; the sixth is broad in front and pointed behind. The dimensions of the neurals are given in the table.

The eighth costals are small, almost vestigial, as in some species of *Platypeltis*, the lateral extent of one being about 22 mm.; of the other, 20 mm. Each lies in a notch in the costal in front of it, and they do not come into contact at the midline, the latter condition being probably an individual peculiarity. The sculpture resembles closely that of Leidy's type. It is thus described by Lambe:

Small, shallow, rounded depressions mark the surface of the neurals and the inner ends of the costals. In the latter, as the distance from the neurals increases, the depressions gradually grow larger and more decided, becoming often reniform or oval, and frequently coalescing, until in the distal ends of the costals a few more or less continuous furrows are formed parallel to the outer margins of the plates. These furrows are a conspicuous feature in the sculpture; they are not so well marked on the posterior margin of the carapace, but are well developed near the front edges of the first costals. In the neurals and inner halves of the costals there is a narrow, smooth strip, devoid of all sculpture, bordering the sutures.

None of the plastral bones referred by Lambe to this species were associated with the carapace described. The author referred to states that the plastral bones belonged to individuals of larger size than that to which the carapace belonged. A comparison of the bones with corresponding parts of individuals belonging to *Platypeltis ferox* and *P. spinifera* shows that the individual represented by the carapace may have been as large as the others or even larger.

In form the plastron (plate 89, fig. 2; text-fig. 644) resembled much that of the living species just mentioned. The sculpture consists of ridges and intervening furrows of varying length and of irregular direction. Of the ridges there are about 9 in a line 20 mm. long. On the outer ends of the bones the ridges run parallel with the long axis of the animal. On the inner half, the ridges are shorter, less elevated, and irregular in their course.

FIG. 644.—*Aspideretes foveatus*. Right hyoplastron and hypoplastron. $\times \frac{2}{3}$. Reduced from Lambe's figure.

hpo, hyoplastron; *hypo*, hypoplastron.

In the collection of fossil vertebrates made in the Judith River basin by Mr. C. H. Sternberg, in 1876, for Professor Cope, there are many fragments of costal bones which belong to this species; but they throw no additional light on it.

From the Laramie beds at Hell Creek, Montana, Mr. Barnum Brown has brought to the American Museum of Natural History fragments of a trionychid that resemble very closely similar fragments from the Judith River basin. Three consecutive neurals and portions of costals have the number 1017. Had they been found in Judith River deposits they would without hesitation be referred to *A. foveatus*. Perhaps only the finding of a complete shell of this Laramie form will settle the questions involved.

The character of the sculpture, especially that of the central regions of the carapace, distinguishes *A. foveatus* from any other of the Judith River species with which it is likely to be compared.

The specimens of *Trionyx foveatus* cited by Prof. O. C. Marsh as having been found in the Ceratops beds near Denver, Colorado, belong probably to *Aspideretes beecheri;* but the present writer has not seen the materials on which Marsh's statement was founded.

Aspideretes coalescens (Cope).

Plate 88, fig. 6; plate 90, fig. 1; text-fig. 645.

Plastomenus coalescens, COPE, Proc. Acad. Nat. Sci. Phila. 1875, p. 9 (no description); Brit. N. A., Bound. Comm. Report on Geol. and Resources 49th Par., 1875, p. 337; Vert. Cret. Form. West, 1875, pp. 93, 261, plate viii, figs. 6, 7.—LAMBE, Ottawa Naturalist, XIII, 1899, pp. 68, 70; Summary Report Geol. Surv. Canada, 1898 (1899), p. 182–190.—HATCHER, Bull. U. S. Geol. Surv. No. 257, 1905, p. 74.

Trionyx vagans, ?COPE, Bull. U. S. Geol. Surv. Terrs., III, 1877, p. 573.—LAMBE, Contrib. Canad. Palæont., III (4 to), 1902, p. 36, plate i, figs. 3, 4, text-fig. 3.

Trionyx coalescens, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

Plastomenus (Trionyx) coalescens, OSBORN, Contrib. Canad. Palæont., III (4 to), 1902, pp. 12, 16.

This species was based on a specimen which was collected in the basin of Milk River, south of Wood Mountain, Assiniboia, British America, and which is now in the collection of the Geological Survey of Canada. Professor Cope's earliest mention of the name was not accompanied by a description; but in the same year both description and figures were publisht. The figures represent the bones half the natural size.

Professor Cope thought that there had been secured portions of both the carapace and plastron of this species; but an examination shows that all the parts belong to the plastron. The bones which furnisht his fig. 6 and 6*a* (Vert. Cret. Form. West, plate viii), instead of being parts of costal plates, are the median ends of the right hyoplastron and hypoplastron; while the original of fig. 7 is made up of other parts of the same bones. In the figure here presented (fig. 645) that portion on the left of the curved line running from A to B is the part represented by Cope's fig. 7, the lower end of the latter figure corresponding to the left side of our fig. 645. The part of the latter figure which lies on the right of the line from A to C represents the same mass of bone as Cope's fig. 6. The portion of our fig. 645 lying in the triangle A B C, except the part dotted, represents a fragment of bone which was present with the others, but which Cope did not bring into relation with the rest of the plastron. This comes into accurate contact with the other two pieces and connects them.

FIG. 645.—*Aspideretes coalescens*. Plastron of type. $\times \frac{1}{3}$.

A, B, C, explained in text; *hyo*, hyoplastron; *hypo*, hypoplastron.

Professor Cope thought too that the sutures between the various bones had been obliterated, but one may be traced from end to end of the united fragments. In Cope's fig. 7 the suture would run perpendicularly thru the middle thereof; while in fig. 6 it would start 23 mm. below the sharp projection to the right of the deep notch on the right side and cross the figure to a point on the upper margin 37 mm. from the extreme left angle of the figure.

We have in this specimen, therefore, a large part of the hyoplastron and hypoplastron of the right side, and belonging to a very large animal. It is quite certain that the remains did not belong to the genus *Plastomenus*.

The width of the plastron, where narrowest, between the axillary and inguinal notches, is nearly 70 mm., and the thickness is 18 mm. Toward the median portion of the bones the thickness is reduced to 10 mm. or less. The process of the hypoplastron which is nearest the hyohypoplastral suture and directed toward the midline is very short, leading to the opinion that the fontanel between the right and left halves of the plastron was narrow.

The ornamentation of the plastral bones which form the type of this species is mostly quite obscure. On the portion of the plastron forming the bridge there are rather coarse ridges forming by their union large pits. Toward the median portion of the plastron the sculpture becomes mostly effaced.

Mr. L. M. Lambe, of the Canadian Geological Survey, has described, under the name *Trionyx vagans*, a large specimen of a trionychid, which he secured in the Belly River deposits, in the region of the Red Deer River, below Berry Creek, in Alberta. The present writer, regarding Cope's type of *Trionyx vagans* as too small and imperfect a fragment for satisfactory comparison with materials from any region, except the type locality in eastern Colorado, is compelled to seek for some more probable disposition of Mr. Lambe's fine specimen. Since the plastron of Cope's *Plastomenus coalescens* indicates a large trionychid which lived in approximately the same region and in the same geological period, it appears to be best to refer the Red Deer River carapace to the same species.

The carapace (plate 90, fig. 1) referred to is nearly complete, wanting only the greater portion of the nuchal; and this was fortunately supplied by another specimen of the same size. The carapace is broader than long, slightly excavated along the anterior border of the nuchal, and truncated behind. The upper surface was rather flat. The total length along the midline is 470 mm.; while the maximum width is 590 mm.

The nuchal has a length, from side to side, of 290 mm. and a fore-and-aft width of 49 mm. Its anterior border is sinuous, being excavated at the midline; its posterior border is rather strongly convex and it joins the bones behind it without intervening fontanel. There is present a preneural and 6 neurals. The preneural is coffin-shaped, with the broad end forward. Its maximum width is 56 mm. The anterior 5 neurals are also coffin-shaped, but, as usual in trionychids, the narrow end is directed forward. The sixth neural is oval and much reduced. No neural is interposed between the costals of the seventh and eighth pairs; and those of the sixth pair meet behind the sixth neural. The costals of the seventh pair are relatively very narrow, only 36 mm. in the middle of the length. The eighth costals are well developt. The nuchal has a thickness of 18 mm. at the outer end; the first costal is 9 mm. thick at the proximal end and 12 mm. at the distal end. The thickness at the center of the eighth costal is 10 mm.

The sculpture (plate 88, fig. 6) consists of a network of usually sharply defined ridges which inclose pits of varying size. The ridges are, for the most part, narrower than the diameter of the pits. Toward the distal ends of the costals the pits are more or less transformed into furrows which run parallel with the free border of the carapace. On the hindermost portion of the carapace the pits are unusually large and the ridges are high. Around the whole border of the shell there is a nearly smooth band. This is broadest at the sides of the carapace. On each side of the costal sutures is a band consisting of low ridges which run at right angles with the suture.

In size, general form, and sculpture, the carapace which has been referred to this species resembles closely that here described as *Aspideretes splendidus*. The two are, however, different in many ways. *A. coalescens* has 6 neurals, while *A. splendidus* has 7. The nuchal of *A. coalescens* is excavated in front and convex behind, while in *A. splendidus* it is convex in front and nearly straight behind. The nuchal of the latter has, likewise, a relatively greater lateral extent. The hinder borders of the two species are somewhat different, that of *A. splendidus* being sinuously convex, with a small median notch, while that of *A. coalescens* is truncated. In *A. coalescens* there is not much difference between the width of the proximal and the distal ends of the costals of the first pair, but in *A. splendidus* the distal ends are much narrower than are the proximal ends. The same statement is true of the seventh costals of the two species. In *A. splendidus* there does not appear the same tendency toward the formation of parallel furrows toward the distal ends of the costals, but rather a tendency toward the production of square cells.

Aspideretes splendidus sp. nov.

Plate 88, figs. 7, 8, 9; plate 91; text-fig. 646

Trionyx vagans, ?Cope, Proc. Acad. Nat. Sci. Phila. 1875, p. 9; ?Bull. U. S. Geol. and Geog. Surv. Terrs., III, 1877, p. 573.— ?Osborn, Contrib. Canad. Palæont., III, 1902, pp. 12, 16.

The specimen which is taken as the type of this species is a large, but somewhat imperfect, carapace in the American Museum of Natural History. It is a part of the Cope collection of reptiles, and was collected for Professor Cope in 1876, by Mr. Charles Sternberg, from the Judith River basin, of Montana. It has now the number 3952. The fragments of which the specimen consisted when it came to the American Museum have been put together, and it is now so nearly complete that almost all portions of the carapace can be determined from one side or the other. A slight doubt now exists only with regard to the presence of a preneural and the amount of extension of the ribs beyond the costal borders.

This species attained a very large size. The width of the type specimen is greater than the length, and the carapace was much deprest. The sides of the carapace are scallopt; there is a slight sinus at the midline behind; and the anterior border formed a gentle curve, with a slight sinus on each side of the midline.

The total length in the midline is 538 mm.; the greatest width, 665 mm. The greatest height of the center of the carapace above the distal ends of the costals is only about 70 mm., but in life the height may have been somewhat greater. The nuchal has an antero-posterior extent of 75 mm., and an extent from side to side of 400 mm. There was probably a preneural bone, but this region is damaged so that the presence of the bone is uncertain. If it was not developt, the first neural must have been very large. Furthermore, there are some appearances in the region in question which indicate that there was a preneural. The probable condition in this part of the carapace is indicated in the text-figure (fig. 646). In the carapace, as restored, there seems to be a suture between the inner anterior angle of the first left costal and a preneural; but the supposed suture may be merely a fracture. There is also a fragment of bone which appears to be a portion of the preneural and a portion of the first neural, but it is uncertain whether or not the fragment belongs where it is placed. If present, the preneural was probably wider at its anterior end than at the posterior. On the other hand, a very large first neural, like that of *Amyda egregia*, may have occupied the entire space between the first costals. The evident relationship of this species to *Aspideretes coalescens* Cope, as figured by Lambe under the name *Trionyx vagans*, renders the presence of the preneural more probable.

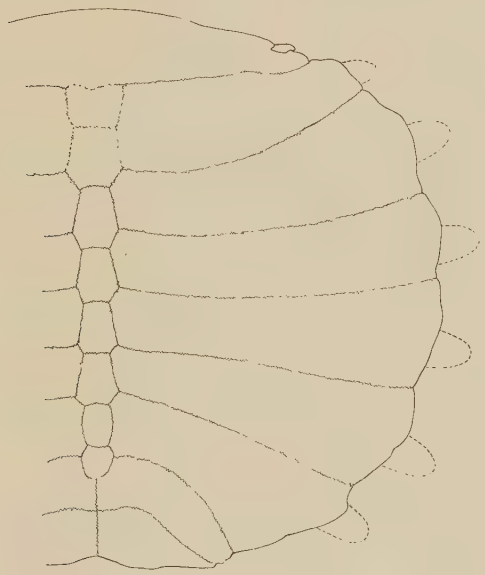


FIG. 646.—*Aspideretes splendidus*. Carapace of type. $\times \frac{3}{22}$. No. 3952 A. M. N. H.

Behind the preneural there were 7 neurals. These had the usual coffin-shape, with the narrower ends directed forward, except the sixth, which is oval in form, and the seventh, which has the broader end in front. The neurals mostly decrease in size from the first to the last. The table below gives the dimensions of the preneural and the neurals.

The first, seventh, and eighth costals are considerably broader at their proximal, than at their distal, ends; and the first is broadest of all, its width near the neural being 88 mm. Distally it is contracted to 52 mm. The next three costals are about 60 mm. wide near the neurals, the second and the fourth about 110 mm. distally, and the third 87 mm. The sixth and seventh costals measure about 50 mm. each proximally, while distally their widths are respectively 108 mm., 133 mm., and 25 mm. The eighth pair meet along the midline for a distance of 46 mm. while they form 230 mm. of the hinder border of the carapace. The thickness of a costal at its sutural border and in the middle of the length is 10 mm., while thru the rib the thickness is 14 mm. At their distal ends the costals are beveled off to an edge.

Element.	Length.	Width.
Preneural.....	40?	56?
Neural 1.....	57?	56
Neural 2.....	60	46
Neural 3.....	52	41
Neural 4.....	54	41
Neural 5.....	48	42
Neural 6.....	42	29
Neural 7.....	33	31

The ornamentation consists of abrupt and narrow ridges which by their union inclose pits and furrows of irregular size and form. There are usually 3 pits or furrows in a distance of 10 mm.; but in places there may be only 2, or again, as many as 4. They are largest on the middle of the lengths of the anterior and middle costals and over nearly the whole surface of the hindermost costals; they are smallest along the middle of the back and on the distal ends of the costals of the anterior half of the shell. Toward the free borders of the costals the pits diminish in size, and finally the beveled border is left nearly smooth. In some places near the distal ends of the costals (plate 88, fig. 8) the pits are nearly quadrate and in rows.

On plate 88, fig. 7 shows the sculpture on the outer third of the second costal, the upper end of the figure being the more anterior, the right side being toward the middle line of the

shell. Fig 8 represents the outer portion of the fourth left costal, the figure being oriented as in fig. 7. Fig. 9 presents the sculpture on the proximal half of the third left costal, the upper end being toward the front of the animal.

This species differs from *A. beecheri* in being more deprest, in having a greater proportionate width, and in having a coarser and more irregular ornamentation. From Cope's type of *Aspideretes? vagans* it seems to differ in having a coarser sculpture. From *A. coalescens* Cope, as exemplified by Lambe's specimen described under the name of *T. vagans*, it differs in having the carapace convex in front and in the different form of the nuchal and in the relatively greater width; likewise, in possessing a greater number of neural plates and much larger eighth costals.

Aspideretes beecheri Hay.

Plate 90, fig. 2; plate 92, figs. 1, 2; plate 96, figs. 1, 2; text-fig. 647.

Trionyx foveatus, Baur, Proc. Acad. Nat. Sci. Phila. 1891, p. 418.— ?Marsh, Monogr. U. S. Geol. Surv. xxvii, 1897, p. 527.

Aspideretes beecheri, Hay, Amer. Jour. Sci. (4), xviii, 1904, p. 274, plate xvi; Amer. Geologist, xxxv, 1905, p. 338.

In the Marsh collection of fossil vertebrates at Yale University, there is a finely preserved specimen of a trionychid to which the above name is given. It was collected in the year 1889, by Prof. J. B. Hatcher and Dr. C. E. Beecher, in the Laramie beds of Converse County, Wyoming, on the east side of Lance Creek. It is named in honor of one of the collectors, Dr. C. E. Beecher, formerly professor of paleontology in Yale University.

This specimen was studied by Dr. G. Baur and was identified by him as *Trionyx foveatus* of Leidy. The present writer does not agree with this identification. Leidy's species was based on scant materials, but the ornamentation of the costal bones is characteristic and has led to the identification of the species by Mr. L. M. Lambe in well-preserved and complete remains. These remains indicate a very different trionychid from the one here described.

The type of *A. beecheri* presents the limbs nearly complete, a portion of the neck, the tail, the shoulder and pelvic girdles, a large portion of the carapace, and the whole of the plastron. The skull, some costals, and most of the neurals are missing.

The carapace (plate 92, fig. 1) was nearly as broad as long, the length being close to 323 mm.; the width 310 mm. It was apparently rather convex, but has suffered some crushing during fossilization. The front of the shell, along the nuchal, was nearly straight, but at the ends of this bone the border has a scallop on each side. The lateral borders are somewhat sinuous. The hinder border appears to have been excavated, but here the costals are wanting.

The nuchal has a width of 30 mm. in the midline, being somewhat notcht for the reception of the preneural. Its outer end appears to project slightly over the first costal plate. The preneural is of hexagonal form, 27 mm. long and 30 mm. wide. The first true neural is hexagonal, with the narrow end forward, as usual in the species of this family. It has a length of 32 mm. and a width of 21 mm. The second neural is of similar shape, 42 mm. long and 26 mm. wide. The costals display nothing characteristic. There were probably 8 of them. The ends of the costal ribs project beyond the disk about 17 mm. anteriorly, but posteriorly they are longer, that of the seventh being about 50 mm., that of the eighth probably about 70 mm. The costals are about 5 mm. thick along their borders.

The sculpture of the carapace consists of a network of ridges inclosing rather deep pits. Of these there are about 5 in a distance of 10 mm. Usually they are without definite arrangement, but toward the outer ends of the costals they dispose themselves in rows parallel with the margin of the shell. The bottoms of the pits are flat, and the walls rise abruptly. In *Aspideretes foveatus* the pits have concave bottoms and the surrounding walls rise gradually. Often, too, there are broad smooth spaces between the pits on the proximal ends of the costals of *A. foveatus*. In *A. beecheri* the sutures between the costals resemble seams in leather sewed with fine stitches.

The plastron is complete. The entoplastron is slightly notcht in front. Its lateral limbs include between them less than a right angle, and the length of each is 93 mm., measuring from the anterior notch of the body of the bone. The epiplastra are broad at their anterior ends. They resemble much those of *Platypeltis mutica*. The hyoplastra are not co-ossified

with the hypoplastra. There are large fontanels in the midline between the bones just mentioned. The hinder of these fontanels is bounded posteriorly by the xiphiplastra. The latter bones appear to have met along the midline without intervening fontanel. Where narrowest the bridge is 64 mm. wide.

The whole lower surface of the hyoplastra, hypoplastra, and the xiphiplastra is covered with a sculpture like that of the carapace, except that it is finer.

The cervical vertebra seen in plate 92, fig. 1, is probably the fifth. Its length from the front of the prezygapophyses to the hinder end of the postzygapophyses is 64 mm.

Seven tail vertebræ are present in a series 122 mm. long but there were others, now missing. The most anterior appears to be the first. These vertebræ are greatly like those of *Platypeltis spinifera*, but the ridge representing the neural spine is low and sharp on the front of the vertebra. Posteriorly it rises, becomes quite rough, and reaches a width of 5 mm. From the highest point it descends to the hinder end of the postzygapophyses, at the same time becoming broader. The centrum of the first caudal has a length of 20 mm. The sacral vertebræ are not preserved.

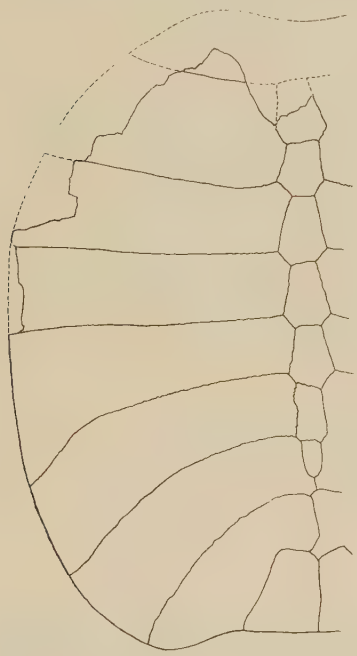


Fig. 647.—*Aspideretes beecheri*. Carapace. $\times\frac{1}{4}$. No. 2358 U. S. N. M.

The left half of the shoulder-girdle is exposed to view. It resembles that of other Trionychidæ. The distal extremity of the coracoid is hidden in the matrix. The procoracoid process has a length of 80 mm. The humerus is not perceptibly different from that of *P. spinifera*. Its length from the proximal surface of the head to the distal end is 95 mm. The ratio of the length of the bone to the length of the carapace is about the same as in the living species referred to above. The radius has a length of 44 mm. Neither ulna is exposed its whole length. The bones of the wrist and hand are somewhat disturbed, but they appear not to have been different from those of living members of the family. The first digit is strongly developt and ends in a large claw phalanx. The claw of the second digit was not so powerful.

The left half of the pelvis is represented by only the anterior portion of the pubis and the hinder process of the ischium. The right half is complete, except that the upper end of the ilium is broken off. From side to side the pubes measured 170 mm. The form of this part of the pelvis is practically that of *Platypeltis spinifera*. The posterior process of the ischium is not so flat as in the species just named.

The femur appears to have been slightly longer relatively to the shell than in *P. spinifera*. The total length in a straight line is 110 mm. The tibia is 67 mm. long. The foot presents nothing distinctive.

It appears probable that this individual was a male well advanced in age.

The U. S. National Museum possesses a specimen which appears to belong to *A. beecheri*. This also was collected for Prof. O. C. Marsh in the Laramie deposits of Wyoming. It bears the catalog number 2358.

There is no part of the plastron present. The median and anterior parts of the nuchal are wanting; also the distal extremities of the first three costals of the right side; large parts of the distal halves of the costals of the left side; and the free extremities of all the ribs.

The carapace (plate 90, fig. 2; text-fig. 647) was high and vaulted. The anterior margin is damaged. The posterior margin is furnisht with a wide shallow sinus. The total length was close to 325 mm.; the breadth was almost exactly the same; the height, not reckoning the plastron, was about 80 mm.

There is a preneural present, but its anterior end is eroded away. Behind this there are 6 neurals, the most posterior being small and wedged in between the proximal ends of the costals of the sixth pair. The anterior 4 have the usual coffin-shape; the fifth is nearly four-sided; the sixth is oval. The table on page 494 gives the dimensions of the preneural and neurals.

Most of the costals are widened at their distal ends. The costals of the sixth pair join medially without interruption. Those of the eighth pair are directed backward, and join for their full length in the midline, their distal ends forming the median portion of the border of the shell. The free borders of the median costals are beveled off at an angle of about 45°; the more posterior ones are rounded on the edge.

Element.	Length.	Width.
Preneural	27±	23
Neural 1	26	25
Neural 2	36	23
Neural 3	33	23
Neural 4	33	22
Neural 5	28	15
Neural 6	18	10

The thickness in the middle of their length is usually close to 6 mm. at the sutures, while thru the rib the thickness amounts to 8 mm. At their distal ends the thickness at the sutural edges is 10 mm. and thru the rib about 12 mm. The ribs are quite prominent on the under side of the costal bones, and occupy about two-thirds of the width of the plate. Most of the bodies of the dorsal vertebræ are eroded away, and there is exposed a cast of a portion of the neural cord about 5 mm. in diameter and 160 mm. long.

The sculpture (plate 96, fig. 2) appears to agree well with that of the type of this species; but it has suffered somewhat from weathering. On the middle of the costals there are 4 or 5 pits in 10 mm. On the neurals and the distal ends of the costals they are somewhat smaller; on the nuchal and in places on the hindermost pair of costals, somewhat larger.

This specimen reveals to us the convexity of the carapace, as well as the form of the hinder border.

Two carapaces have been submitted to me for examination, which had been collected by Prof. J. B. Hatcher in the Judith River beds on Fish Creek, Montana. These bear the numbers 445 and 541 of the Carnegie Museum, Pittsburg. No characters are observed which serve to distinguish these carapaces from that of the type of *A. beecheri*. It is not improbable, however, that they belong to a distinct species.

Prof. O. C. Marsh, as cited in the synonymy, has reported *Trionyx foveatus* from the Ceratops beds near Denver, Colorado. The writer does not know on what the determination was based; but it appears probable that the specimens belonged to *A. beecheri*.

Aspideretes fontanus sp. nov.

Text-fig. 648.

From the Laramie beds at Ojo Alamo, San Juan County, New Mexico, Mr. Barnum Brown, of the American Museum of Natural History, in 1904, brought materials belonging apparently to 3 species of the genus *Aspideretes*. Of these the present is represented by nearly the whole of the right half of the nuchal and a considerable part of the right first costal. The number of the specimen is 6070.

FIG. 648.—*Aspideretes fontanus*. ×⅔. Part of nuchal and part of first right costal of type.

At no point does this piece of nuchal come to the midline; hence we can not determine the exact extent of the bone laterally. It was, however, not far from 260 mm. The animal was therefore one of considerable size. The inner hinder angle of the bone presents a part of the sutural border for the preneural, and from this to the outer end of the nuchal is 125 mm. The width of the bone, where it came into contact with the preneural, is 60 mm. The anterior border is not beveled, but is cut off nearly at right angles with the upper surface. The greatest thickness, thru

the ridge on the lower surface, is 16 mm. Where it made contact with the preneural the thickness is only 4 mm.

The portion of the costal, the proximal half, almost certainly belongs to the same individual. At its proximal end it presents the sutural borders for the preneural and the first neural. Evidently the preneural was somewhat wider than the neural. Its length was at least 40 mm. The border of the costal for union with the neural is 7 mm. thick. About the middle of the length of the hinder border of the costal the thickness is 7 mm.

The upper surface of the bone is incrusted with a layer of iron oxide; but so far as can be discovered the sculpture was finer than in the other two species found in that region, *A. austerus* and *A. vorax*. The few pits observed appear to be about 2.5 mm. in diameter.

The respects in which this species differs from those just named are mentioned under their respective descriptions.

Aspideretes austerus sp. nov.

Text-figs. 649, 650.

The fragmentary specimen on which the present species is based was collected in 1904, by Mr. Barnum Brown, from Laramie deposits at Ojo Alamo, San Juan County, New Mexico. The catalog number of the specimen is 6068. The remains, belonging apparently to a single individual, consist of the nuchal except the central portion, part of both first costals, the greater part of a right posterior costal, probably the sixth, various fragments of costals, a piece furnishing parts of two neurals, and a considerable portion of the right hypoplastron.

The species is characterized by the very thick bones and the coarse sculpture of both the carapace and the plastron.

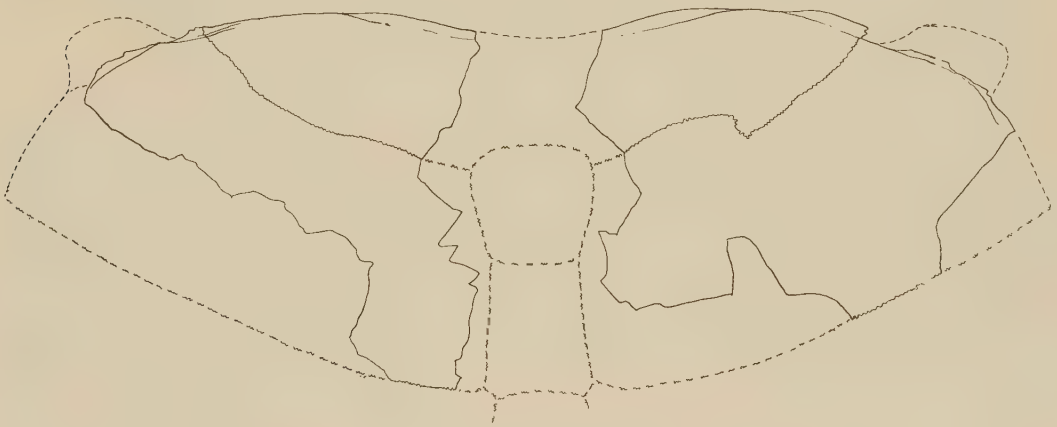


FIG. 649.—*Aspideretes austerus*. $\times \frac{2}{3}$. Parts of nuchal and first costals of type.

On account of the missing middle region of the nuchal, the exact lateral extent of this bone can not be determined. It was, however, not far from 230 mm., being thus somewhat less than that of *A. fontanus*, just described. The greatest width is 45 mm., a fourth less than that of *A. fontanus*. The greatest thickness of the bone is 21 mm. The free anterior border is not beveled, but is cut off at nearly right angles with the upper surface, like that of the species just mentioned. The thickness of this border varies from 10 mm. toward the midline to 15 mm. near the outer end.

The first costal is about 72 mm. wide near the neural border and it increases to 80 mm. near the distal end. The free border is cut off at a nearly right angle to the upper surface. The thickness of this border is 10 mm. or more. The hinder border of this bone is 10 mm. thick.

The posterior, probably the sixth, costal is 25 mm. wide 110 mm. from the distal end, but it widens rapidly to 55 mm. The free border is like that of the first costal. There must have been a considerable notch between this costal and the one next behind. In thickness this costal ranges between 9 mm. near the proximal end and 10 mm. at the distal end.

The sculpture of the carapace is best displayed toward the free borders. It consists of abruptly sunken pits, of which there are usually 5 in a line 20 mm. long. Closer to the free borders the pits are smaller. Nowhere does there appear any tendency for the formation of straight rows of pits, such as are seen on the costals of *Amyda cariosa*, of the New Mexico Wasatch. On the portions of the carapace near the midline the pits are less conspicuous. They appear to be as large, but the walls appear worn down.

FIG. 650.—*Aspideretes austerus*. $\times\frac{2}{5}$. Right hypoplastron of type.

The hypoplastron (fig. 650) is thick and heavy. At the suture with the hyoplastron, not far from the midline, the thickness is 13 mm. One border of the notch for the process of the xiphiplastron remains. This bone was articulated with the hypoplastron by a jagged suture and it must have extended anteriorly near the midline. The outer end of the hypoplastron, near the bases of the lateral processes, is 16 mm. thick.

Evidently nearly the whole lower surface of the plastron was covered by the sculptured layer. The pits are smaller than those of the carapace, there being about 7 pits in a line 20 mm. long. Many of them coalesce to form winding furrows.

This species differs from *A. fontanus* in having a narrower nuchal, much thicker bones, and a considerably coarser sculpture. It is referred to *Aspideretes* provisionally.

Aspideretes vorax sp. nov.

Text-fig. 651.

This species was collected from the Laramie deposits near Ojo Alamo, San Juan County, New Mexico, in 1904, by Mr. Barnum Brown. The type is in the American Museum of Natural History and has the catalog number 6140. The species is represented, as far as known, by only the nuchal bone; but this is complete. The length of the bone, from side to side, is 200 mm. in a straight line, 215 mm. over the curve. The lateral convexity is considerable and appears to have been somewhat greater than that of either *A. austerus* or *A. fontanus*, both from the same locality as this species. The width at the midline is 45 mm., the greatest width, 55 mm. The greatest thickness is 15 mm. There is a moderate median sinus in the anterior border. This border is not clipt off at a nearly right angle with the upper surface as in the two other species mentioned above; but is beveled down on the upper surface of the bone to a sharp edge. This beveled surface is not sculptured. The hinder border of the bone presents a median excavation, for the preneural bone. The latter bone was evidently unusually broad, the excavation having a width of at least 55 mm. The preneural border is thicker than that of *A. fontanus*, the thickness being 7 mm.

FIG. 651.—*Aspideretes vorax*. $\times\frac{2}{5}$. Nuchal bone of type.

The sculpture of the bone is obscured by a layer of hard matrix; but so far as can be determined, it was intermediate between *A. fontanus* and *A. austerus*, approaching more closely the latter.

Certain fragments of costals present probably belong to this species, but possibly to *A. fontanus*. One of these, apparently the right sixth, is 35 mm. wide at the neural border, 30 mm. wide more distally, and has a thickness of 8 mm.

This species differs from *A. fontanus* in having the free anterior border of the nuchal beveled, the bone thicker at the preneural border, and a coarser sculpture. From *A. austerus*

it differs in having a nuchal with greater antero-posterior width, the bone not so thick, and with the free anterior border beveled off, instead of being clipt off at a right angle with the upper surface.

Aspideretes? vagans (Cope).

Plate 96, fig. 3.

Trionyx vagans, Cope, Ann. Report U. S. Geol. and Geog. Surv. Colorado, 1873 (1874), p. 453; Bull. U. S. Geol. and Geog. Surv. Terrs., 1, No. 2, 1874, p. 29; Vert. Cret. Form. West, 1875, pp. 96, 260, plate vi, fig. 13.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.—Hatcher, Bull. U. S. Geol. Surv. No. 257, 1905, p. 73.

The type of this species is a fragment of a costal plate, which was collected by Professor Cope in 1873, from what have usually been regarded as Laramie deposits in Colorado. From Whitman Cross (Monogr. U. S. Geol. Surv., xxvii, 1896, p. 244) we learn that the more exact locality is on Bijou Creek, 40 miles east of Denver. Mr. Cross believes that the deposits belong to the Arapahoe beds, of the Post-Laramie.

The type fragment has a length of 50 mm., a width of 37 mm., a thickness at the sutural borders of 5 mm., and thru the rib, of 6 mm. It was figured by Cope in 1875, as cited. Another figure of it is presented on plate 96, fig. 3. This specimen is now in the American Museum of Natural History and has the number 1847. The other fragment figured by Cope at the same time has been lost. Still other fragments were mentioned in the original description, but were not described and they have now disappeared.

It is to be remarkt of Cope's figure of the type specimen that it brings out the ridges into too great contrast with the pits. The latter are really very shallow, and they rise gradually from the bottom to the summits of the surrounding walls. For this reason Hatcher's remarks (op. cit. p. 74) regarding Lambe's Judith River form are not pertinent.

Various specimens from Montana, Wyoming, and Canada have been referred to this species; but after careful comparison, the writer has come to the conclusion that it is impossible to identify any of them with Cope's type. It seems best, therefore, to describe and name specimens from other localities without regard to it, until better materials have been collected in the type locality.

Whether or not the fragmentary materials which Cope has referred to this species from near the mouth of the Big Horn River, in Montana, from the Judith River beds, from North Dakota, and from the Milk River region of British America, belong to it is extremely doubtful. Some of them probably belong to the species here described as *A. splendidus* Hay, *A. beecheri* Hay, and *A. coalescens* Cope.

It is to be noted that in the Vertebrata of the Cretaceous Formations of the West, Cope states that there are 4 or 5 pits in 19 mm. This is evidently a typographical error; for in the original description there are said to be 4 or 5 pits in 10 mm., which is correct.

Aspideretes sagatus sp. nov.

Plate 93, figs. 1–3; text-fig. 652.

This species is represented in the collection of the American Museum of Natural History by a complete carapace. It was collected in the year 1892, in the Puerco deposits of New Mexico. The catalog number is 1201.

This carapace (plate 93, fig. 1; text-fig. 652) is approximately circular in form, having a length of 375 mm. and an extreme breadth of 312 mm., exclusive of the projection of the rib-ends beyond the margin of the shell. The front margin of the nuchal plate, in the midline, is slightly concave. Behind, the shell is narrowly truncate. Transversely the shell was moderately convex, less so longitudinally. All around the margin the carapace is beveled off rather abruptly, and concavely, so as to produce a broad shallow groove. Nowhere does the sculptured layer overhang the free portions of the ribs or the deeper layers of bone. The bone has a thickness of about 9 mm. It is somewhat thicker in the middle of the width of the costal plate, but not much. The costal plates also grow slightly thicker toward their free margins.

There are 2 plates between the proximal ends of the first pair of costal plates, a preneural and a neural. The preneural is a trapezoid, whose broadest side, 50 mm., articulates with the nuchal, while its shortest side, 22 mm., joins the first neural. The median length is 29 mm.

Neural.	Median length.	Greatest width.
1	34	25
2	37	24
3	33	23
4	32	22
5	30	16
6	20	9

The first neural is hexagonal with the long sides parallel. The second, third, fourth and fifth neurals are coffin-shaped; the sixth neural is pentagonal and pointed behind. The table herewith gives the dimensions of the neurals.

The nuchal is firmly joined by its whole posterior border to the first costal plates and to the preneural. Its antero-posterior length is 38 mm.; its width from side to side is close to 154 mm. Its whole upper surface, with the exception of the beveled edge, is covered with the ridges and pits of the ornamentation. It is therefore in form, in extent of articulation, and ornamentation extremely different from the nuchal of *T. puercensis*.

The eighth pair of costals together form about 125 mm. of the hinder margin; fore and aft in the middle line they measure 38 mm.

The sculpture (plate 93, figs. 2, 3) consists of a coarse network of ridges which inosculate somewhat irregularly and inclose deep pits of varying sizes. The sculpture is coarsest on the distal third of the costal plates, where there are about 5 pits in a line 25 mm. long; and here there is a tendency toward an arrangement of the stronger ridges across the costal plates. Nearer the midline of the shell there will be found about 6 or 7 pits in this distance. Near the free margins of the costal plates there is a tendency for the ridges to break up into tubercles having elongated or circular bases. It might be difficult in some cases to distinguish fragments of the shell of *T. puercensis* bearing its coarser sculpture, from fragments of the present species bearing the finer ornamentation. If they are marginal pieces the species may be determined usually from the fact that the margin of *P. puercensis* is beveled off less abruptly and with a plane or convex surface, while that of *P. sagatus* has the bevel abrupt and often slightly concave.

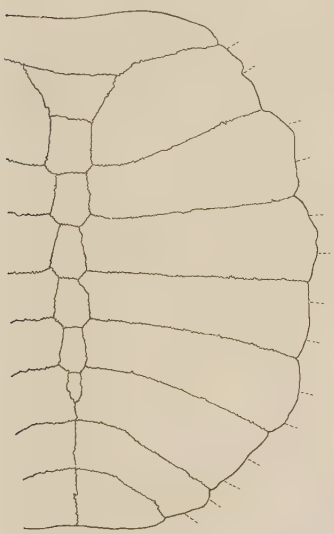


FIG. 652.—*Aspideretes sagatus*. Carapace of type. $\times \frac{1}{5}$.

This species resembles in many ways those figured by Professor Cope on plate xxvi of his Extinct Vertebrata obtained in New Mexico (Wheeler Survey West 100th Meridian, vol. IV). *A. sagatus*, however, differs from *T. leptomitus* and *T. cariosus* in not having the sculptured layer of bone overhanging the supporting layers at the outer ends of the costal plates; likewise, in not having the ridges of the sculpture arranged in lines parallel with the length of the shell.

Aspideretes? nassau sp. nov.

Text-fig. 653.

The only known specimen of this species was collected by Dr. Marcus S. Farr, of Princeton University, Princeton, New Jersey, in Fort Union deposits, at Duffy's ranch, 18 miles from Melville, Sweet Grass County, Montana. The specimen belongs to the university named. Only the carapace (fig. 653) is represented.

The nuchal bone, all of both first costals except a small part of the one of the right side, and the first and second neurals are missing. It is assumed that this species, like those from the approximately equivalent Puerco deposits, possest a preneural bone and belonged, therefore, to the genus *Aspideretes*. There were certainly 8 pairs of costals and 7 neurals.

The individual here described was evidently an aged one, since the disk extended out to the ends of the ribs. The species was a small one. The length can not be exactly determined, but was approximately 195 mm. The width, in a straight line, is 200 mm. The rear of the carapace is truncated, more exactly, slightly concave in outline. The upper surface is convex from front to back, more strongly so from side to side. The free borders are cut off nearly perpendicularly to the upper surface and are about 9 mm. thick. Toward their proximal ends the costals are reduced in thickness to 5 mm.

The neurals are relatively broad. The accompanying table shows their dimensions.

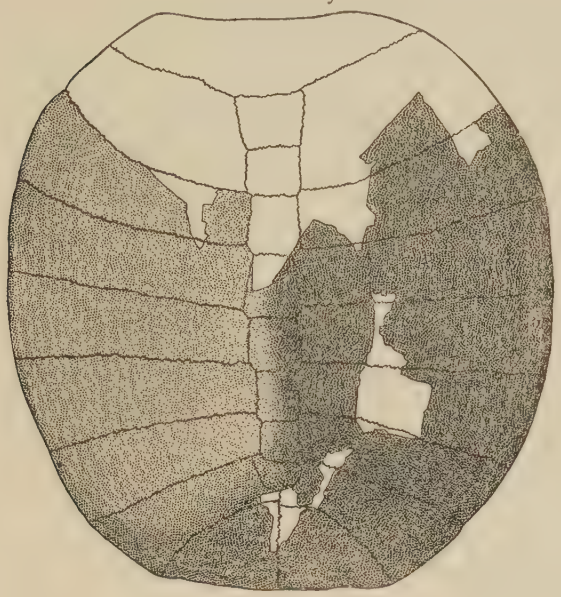


FIG. 653.—*Aspideretes nassau*. Carapace of type. ×0.35. Partly restored.

It is not certain that the outlines of the seventh neural are correctly drawn in the figure; but they appear to be as shown. If so, this neural is of unusual form and size for the posterior one. It did not wholly separate the costals of the seventh pair at the midline.

Neural.	Length.	Width.
3	20	19
4	19	18
5	17	15
6	15	13

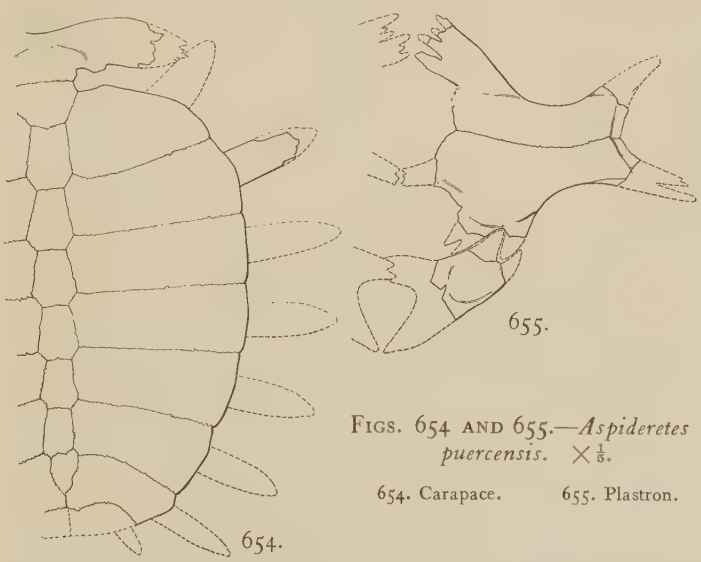
The central portions of the upper surface of the carapace are nearly smooth. Gradually toward the outer borders a sculpture appears. On a band about 35 mm. wide around the borders this sculpture is quite distinct and consists of ridges separated by furrows and pits. These ridges run nearly parallel with the free borders of the carapace. The furrows are usually narrower than the flat-topped ridges. A line 10 mm. long crosses four of the ridges.

Nassau, an old name for Princeton University.

Aspideretes puercensis sp. nov.

Plate 94, figs. 1–3; plate 104, figs. 2, 3; text-figs. 654, 655.

This species is represented by a single specimen, which belongs to the American Museum of Natural History, and bears the number 1202. The right side of the carapace is nearly complete, lacking only the eighth costal and the free ends of most of the ribs; and there are present large portions of the left side of the plastron. All these parts belonged to a single individual, which was collected by Dr. J. W. Wortman and Mr. O. A. Peterson, in 1892, in the Puerco beds of New Mexico, probably in the southern part of Rio Arriba County.



FIGS. 654 AND 655.—*Aspideretes puercensis*. ×$\frac{1}{8}$.

654. Carapace. 655. Plastron.

Up to the present time, no species of Trionychidæ has been described from the Puerco Eocene except *Conchochelys admirabilis* Hay. Professor Cope has credited (Proc. Amer. Philos. Soc., XX, p. 461) to the Puerco deposits the Wasatch species *Plastomenus communis*, but it was with a doubt, and the species was not included in later lists. Nor is it mentioned in Cope's Vertebrata of the Tertiary Formations of the West as belonging to the Puerco.

The carapace (plate 94, fig. 1) of the type of this species had a length of 330 mm. and a breadth of 263 mm., not including the extension of the ribs beyond the costal plates. If we include the ribs, the width was at least as great as the length.

The nuchal is a considerable bone, having had an extension from side to side of about 175 mm., and a width of about 35 mm. at the midline. Anteriorly it is somewhat excavated, while posteriorly it is articulated with the preneural. It was not in contact with the anterior costal plates, but its distal extremity probably overlapt the distal end of the rib of the first costal. The connection of the nuchal with the bones behind it was, therefore, a rather loose one. In Bell's Monograph of the Testudinata there is a figure (plate liv) of *Trionyx labiatus* (*Testudo triunguis* Forskal) which shows a nuchal much like that of the fossil species here described. The living species differs, however, from *A. puercensis* in not having the nuchal articulated to either a costal plate or a median bone, only overlapping the ends of the ribs projecting from the first costal plates.

The nuchal of *A. puercensis* is thin, except for a rib-like thickening which follows the length of the bone on the lower side. The lateral wings terminated in digitations. On the upper side the bone is smooth and was covered with soft tissue, except a patch in the midline, 48 mm. from side to side and 25 mm. fore and aft. This has the sculptured surface found elsewhere on the carapace. Around this area, on the sides and behind, the bone is beveled off in continuation with the beveling of the edge of the rest of the carapace.

Element.	Length.	Width.
Preneural.....	28	50
Neural 1.....	40	30
Neural 2.....	39	30
Neural 3.....	35	28
Neural 4.....	34	27
Neural 5.....	34	25
Neural 6.....	28	18
Neural 7.....	28	15

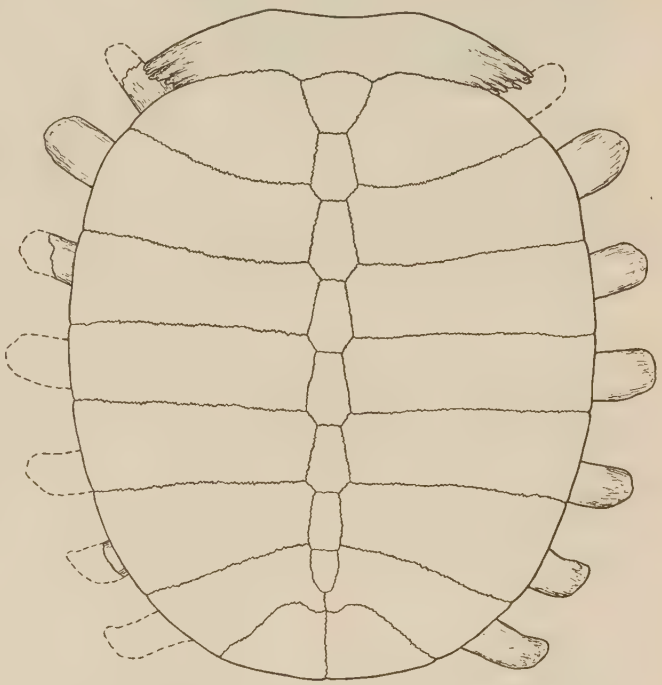


FIG. 656.—*Aspideretes singularis*. ×¼. Carapace of type.

Between the proximal ends of the first costals we find 2 bones, a preneural and the first neural. The former is irregularly pentagonal, with the broadest side articulating with the nuchal. The two shortest sides lie in a notch of the first neural. The anterior 5 neurals are elongated hexagonal, with the broadest end directed posteriorly. The next neural is quadrilateral, while the last is nearly triangular. The dimensions of the preneural and the neurals are given in the table.

The first costal is the broadest of all. In front and laterally it is beveled off from the sculptured layer to the inner surface. Medially it articulates with the preneural and with the long side of the first neural. The width of the succeeding costals diminishes toward the rear.

The thickness of the costals is pretty uniformly 7 mm. near the sutural borders, and 9 mm. thru the rib. The latter extended beyond the edge of the costal plates for a considerable distance; in the case of the rib of the second costal, somewhat more than 50 mm. The ribs are broad, occupying about half the width of the costal plates.

Of the plastron (plate 104, figs 2, 3; text-fig. 655) there are present the left hyoplastron, the left hypoplastron, and part of the right xiphiplastron. These elements do not differ in any important respect from the same bones in living Trionychidæ. Altho they are quite thick, they are not unusually large. The width of the hyoplastron and the hypoplastron taken together, measured across the narrowest part, is 55 mm.; and of this width each occupies one-

half. Toward the midline the hypoplastron becomes much wider than the hyoplastron. The hypoplastron sends inward a finger-like process, which no doubt joined a similar process from the bone of the opposite side. The median border of both bones was very obliquely beveled. The greatest thickness of the hypoplastron is 12 mm. The xiphiplastron present appears to belong to the right side. It has a central, thick portion, sculptured, oval, 25 mm. wide, and about 40 mm. long. This passes by a bevel into the thinner portion on all sides. The thinner part extended forward into digitations joining the hypoplastron, and posteriorly into others which connected with the corresponding bone of the opposite side. It is evident that there were large fontanels between the right and left halves of the plastron.

The sculpture (plate 94, figs. 1–3) consists of a network of ridges which inclose pits of rather regular form and size. The pits are of somewhat greater diameter than the ridges surrounding them. On the neurals there are about 5 pits in 12 mm., while on the hindermost costals there are only about 3 in the same distance. The pits increase somewhat in size from the proximal toward the distal ends of the costals. There is no tendency, near the free margins of the costals, toward either the disappearance of the ridges or toward their breaking up into tubercles. There are no welts on the surface such as we find in species of *Plastomenus*.

The sculpture of the plastron is greatly like that of the carapace. The sculptured part of the hyoplastron is nowhere more than 30 mm. wide, while that of the hypoplastron is 53 mm.

Aspideretes singularis sp. nov.

Figs. 656–662.

The type of this species is a nearly complete specimen which was collected for Prof. E. D. Cope, by Mr. David Baldwin, in 1883, from the Torrejon beds of Chaco Canyon, San Juan County, New Mexico. It furnishes the oldest-known trionychid skull that is accompanied by the shell. *Conchochelys admirabilis*, of the underlying Puerco beds, furnishes an older skull, but the shell is entirely unknown.

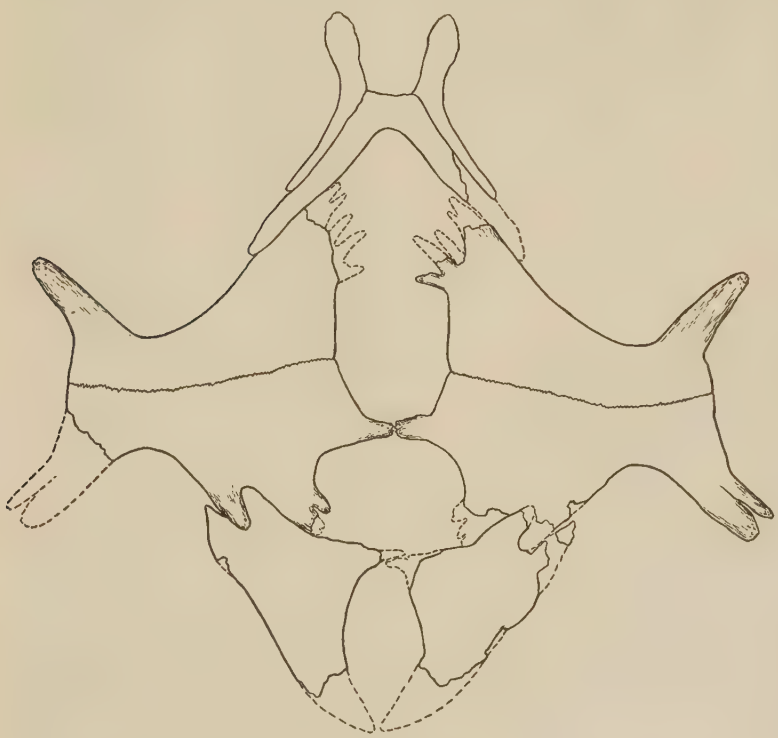


Fig. 657.—*Aspideretes singularis*. Plastron. ×¼.

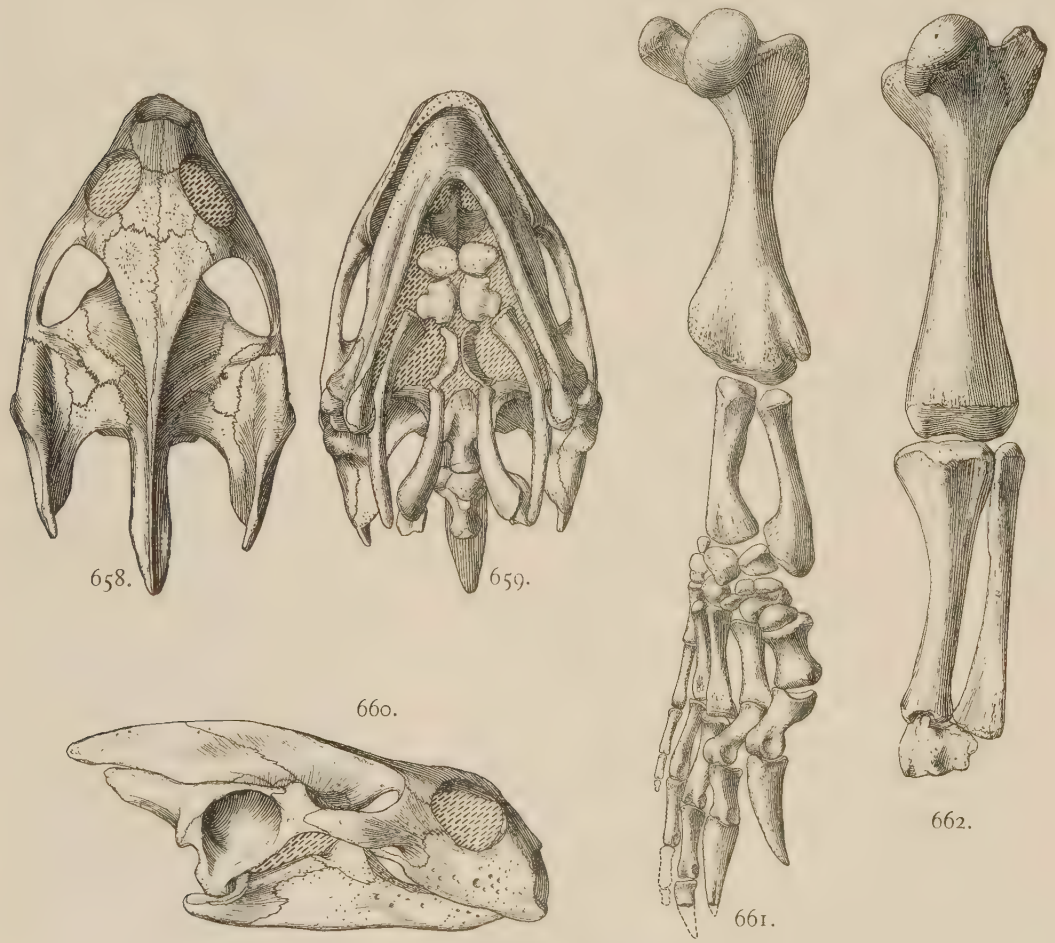
The carapace (fig. 656) must have been rather convex, but the convexity was probably increast during fossilization. The length is 350 mm. The width of the disk could not have exceeded 280 mm. Beyond this the rib-ends extend 50 mm. on each side. Therefore the whole width of the carapace was about 380 mm. It is composed of the nuchal, a preneural, 7 neurals and 8 pairs of costals.

The nuchal extends from side to side 190 mm.; fore and aft, 37 mm. The outer ends of the bone are smooth, the central portion is pitted. The free borders of the carapace are beveled and smooth, but the general surface is carved into ridges and inclosed pits. On the neurals and adjoining parts of the costals the pits are nearly circular and there are 3 or 4 of them in a line 20 mm. long. Distally the

pits are larger. On the outer ends of the costals the pits are mostly in rows and there are only three or four in a line of the length given.

All the parts of the plastron (fig. 657) are present. The limbs of the entoplastron are 112 mm. long. The epiplastra are 18 mm. broad anteriorly and about 100 mm. long. The hyohypoplastral suture is 143 mm. long. The bridge is 56 mm. wide. Each xiphiplastron is 110 mm. long and 75 mm. wide. The sculpture of the plastron is finer than that of the carapace.

The skull (figs. 658–660) is complete and little distorted. It resembles closely that of *Platypeltis ferox*, but the profile descends more abruptly from the middle of the orbits. The length from snout to occipital condyle is 102 mm. From the outside of one quadrate to that of the other is 67 mm. The orbits are large, the diameter being 20 mm. The roof of the mouth



FIGS. 658–662.—*Aspideretes singularis*. Parts of type. $\times\frac{1}{2}$.

658. Upper view of skull. 659. Lower view of skull.
660. Right side of skull. 661. Fore leg. 662. Hind leg.

is mostly concealed by the bones of the tongue. It is seen, however, that the choanæ are placed 25 mm. behind the tip of the snout. The shoulder-girdle and bones of the foreleg (fig. 661) differ little from those of the living species just mentioned. One forefoot is nearly complete. The pelvis and hinder limbs (fig. 662) offer no peculiarities. The bones of the hinderfeet are not completely preserved.

The sculpture of this species resembles that of *A. sagatus* and *A. puercensis*. From the former it differs in having a larger portion of the nuchal bone devoid of sculpture and in having this bone extend much farther across the outer end of the first costal. From *A. puercensis* it differs in having the nuchal more closely joined to the first costals and a coarser sculpture on the outer ends of the costals. There are differences in the plastra of the two species.

Aspideretes? guttatus (Leidy).

Text-figs. 663, 664.

Trionyx guttatus, LEIDY, Proc. Acad. Nat. Sci. Phila. 1869, p. 66; U. S. Geol. Surv. Wyoming, etc., 2d (4th) Ann. Rept. F. V. Hayden, 1871, p. 367; U. S. Geol. Surv. Montana, etc., 5th Ann. Rept., F. V. Hayden, 1872, p. 370; Cont. Ext. Vert. Fauna West. Terrs., 1873, pp. 176, 342, plate ix, fig. 1.—COPE, Ext. Bat., Rept., and Aves N. A., 1869, pp. 151, 152; U. S. Geol. Surv. Terrs., 6th Ann. Rept. F. V. Hayden, 1873, p. 617; Vert. Tert. Form. West, 1884, p. 119.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

Aspideretes? guttatus, HAY, Amer. Geologist, XXXV, 1905, p. 335.

Dr. Joseph Leidy's type of this species was discovered at Church Buttes, near Fort Bridger, Wyoming, in the beds of the Bridger Eocene. It consists of a portion of the third neural plate, the fourth, fifth, sixth, and seventh neurals; portions of the third, fourth, fifth, and sixth costals of the right side; the proximal ends of the fifth, sixth, seventh, and eighth costals of the left side; and the complete seventh and eighth costals of the right side. The materials are therefore not very satisfactory. The form of the shell can not be determined, nor with certainty the presence or the absence of a preneural. The species has here been referred with doubt to *Aspideretes*. To add to our difficulties the type appears to have disappeared from view. Cope referred to this species some of the materials collected by him in the Bridger beds, but his specimens were very fragmentary and do not appear to have furnisht him with additional information. It is questionable whether or not the nearly complete carapace collected by him in the Wasatch beds of New Mexico really belongs to the species. Unfortunately this carapace is now lost, along with the greater part of Cope's other remains from that region.

Leidy supposed that the carapace described by him had originally had a length of about 375 mm. The bones had a thickness of about 8 mm. Most of the neurals are nearly twice as long as wide, and there is a reduced one between the costals of the seventh pair. The costals and neurals are described as being sculptured for the most part with broad, rounded, and isolated concave pits resembling the impression of rain drops on a soft surface. Near the borders of the shell these become somewhat confluent. The walls surrounding the pits are broad and low and often as wide as the pits. There are 2.5 or 3 of these pits in a line 10 mm. long.

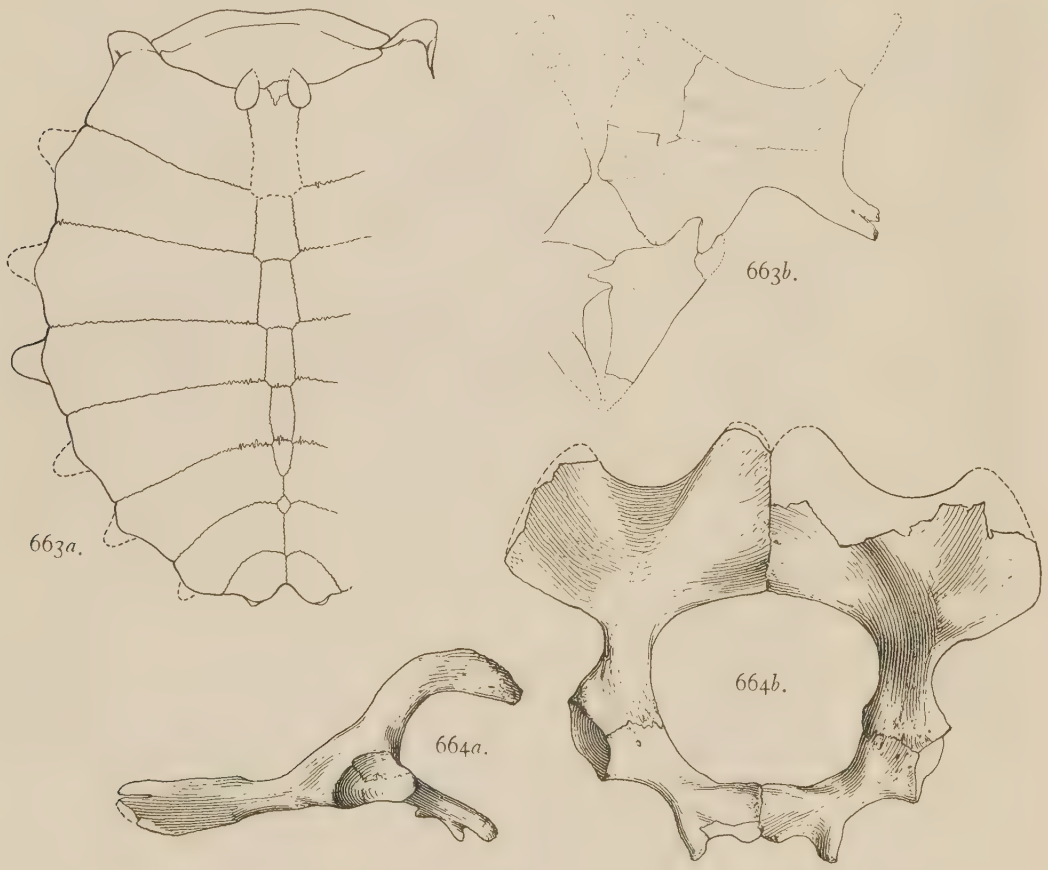
The American Museum expedition of 1903, sent into the Bridger region near Fort Bridger, secured, in the Grizzly Buttes, a specimen, No. 6005, which is referred with confidence to this species. It consists of a portion of the carapace corresponding nearly with that of the type, together with a large portion of the plastron. The fragment of the carapace agrees in all essential respects with the figure and description furnisht by Leidy. However, the sixth neural plate is segmented into two portions. The costals appear to have been somewhat thicker, ranging from 7 mm. to 10 mm. The distance from the hinder border of the eighth costal to the anterior border of the sixth is 112 mm. In Leidy's specimen this distance, according to his figure, was 133 mm. Fig. 663*a* is composite, being constructed partly from the specimen just described and partly from No. 5993 A. M. N. H., described below.

The plastron (fig. 663*b*) is represented by nearly the whole of the right hyoplastron and a fragment of the left; the whole of the right hypoplastron and a fragment of the left; and both nearly complete xiphiplastra. At its median end the border of the hypoplastron is filled out to the extremity of the process which meets that of the opposite bone at the midline, thus indicating an old individual. The bones are thick and heavy. On the bridge, at the suture between the hyoplastron and the hypoplastron, the thickness is 17 mm. The bridge, where narrowest, is 79 mm. wide. Of this width the hyoplastron occupies 49 mm. Nearly the whole of the lower surface of both bones is roughened or granulated. However, the outer end of the hypoplastron is sculptured with ridges and tubercles, of which there are about six in a distance of 10 mm. A similar, but more indistinct sculpturing occupies the lower surface of the outer end of the hyoplastron.

The xiphiplastra are triangular in form, and had a fontanel between their inner borders. Each has 2 processes for articulation with the corresponding hypoplastron. Two processes of the left xiphiplastron received between them a single process of the right. The lower surface of the two bones is roughened, but not sculptured.

Fig. 664 represents the pelvis of this specimen.

A specimen of a large trionychid collected in 1903, in the western part of Grizzly Buttes, is referred to this species. Its catalog number in the American Museum of Natural History is 5917. It consists of the outer ends of the nuchal, the greater portion of the right first costal, the outer ends of the left first and second costals, various portions of other costals, 1 neural, and fragments of other parts of the skeleton. The individual was a large one. The first costal near its proximal end was about 75 mm. wide fore and aft; the second costal has a width equally great. The sculpture appears to be identical with that of No. 6005, consisting of large flat-bottomed pits, surrounded by walls with rounded summits. As in No. 6005, there is a band near the free margins of the carapace which has no pits, but which presents a fine network of bony fibers, resembling a textile fabric. On the rear of the carapace of No. 6005 this band is narrow. In the case of No. 5917 the band is considerably broader, 25 mm. or more.



FIGS. 663 AND 664.—*Aspideretes guttatus.*

663*a*. Carapace. $\times\frac{1}{6}$. 663*b*. Plastron. $\times\frac{1}{6}$.
664*a*. Pelvis, seen from left side. $\times\frac{1}{3}$. 664*b*. Pelvis, seen from below. $\times\frac{1}{3}$.

The width of the outer end of the nuchal bone exceeded 65 mm. The length of the bone from side to side was about 230 mm. Apparently only a relatively narrow strip on the posterior border of the nuchal was occupied by a pitted surface. In front of this there was an area about 25 mm. wide with the textile-like appearance noted above. The ends of this element present ordinary bony tissue. The outer extremities of the nuchal overlapt the free ends of the ribs of the first costals.

The sutural borders of the costals present a band devoid of pits and is finely striated at right angles to the sutures.

Future discoveries must decide whether or not this identification of No. 5917 is correct.

Still another specimen, No. 5993, collected in 1903, in the eastern part of the Grizzly Buttes, must for the present be referred to *A. guttatus*. The carapace is nearly complete, but,

like No. 5917, lacks the median portion of the nuchal and the anterior neurals. Furthermore, the sculptured layer has been split off the nuchal. The length of the carapace was close to 420 mm.; the width, 360 mm. The sixth neural was not completely developt and it permits the costals of the sixth pair to join behind it. The seventh neural is only 15 mm. long and 10 mm. wide, and it is wedged in between the sixth and seventh pairs of costals.

The nuchal had a width of 60 mm. from front to back, at a short distance from the midline. It is evident from the right fragment of the nuchal and the right first costal that there was between the nuchal and the first costals, one on each side of the first neural, a pair of fontanels. Similarly placed fontanels are found in *Platypeltis leucopotamica*. In *A. guttatus* these fontanels were about 25 mm. fore and aft and at least 20 mm. from side to side. Between the fontanels of No. 5993 is a small triangular plate of bone which may represent the preneural. On account of this bone, this species is referred to the genus *Aspideretes*. Without this it would fall into the genus *Amyda*.

This specimen is nearly devoid of the smooth marginal band of interlaced bony fibers so conspicuous in No. 5917.

As stated above, Professor Cope furnisht a brief description of a nearly complete carapace obtained by him in the Wasatch beds of New Mexico and referred by him to this species (Wheeler Survey, IV, p. 46). According to this description the nuchal underran the first costal. This is not the case with the specimen described above and it is concluded therefore that the Wasatch specimen does not belong to the same species as Leidy's type.

Aspideretes ellipticus sp. nov.

Plate 95, figs. 1–3; text-figs. 665, 666.

The description of this species is based on No. 1117 of the American Museum of Natural History, a specimen which was obtained in the Bridger beds of northeastern Utah by the American Museum Expedition of 1893.

The carapace (plate 95, fig. 1; text-fig. 665) is complete; the plastron is wholly missing. In form the carapace is more elongated than usual, rounded in front, only slightly truncated behind. The borders, especially the anterior and lateral, are sinuous. From side to side the carapace is gently archt. The total length is 400 mm.; the width, not regarding the convexity, is 305 mm. The greatest width is at the middle of the length, and from this the margin proceeds with similar curves forward and backward. The thickness of the costals is about 9 mm. at the sutures, but somewhat greater thru the ribs. Along the sides of the carapace the upper and lower layers of the bones project beyond the median layer, thus producing a groove. The lower layer extends far out on the distal ends of the ribs.

Behind the nuchal there is a preneural, followed by 6 neurals. The table herewith presents the measurements of these bones.

The forms of these bones are shown in the figures.

The nuchal has an antero-posterior extent of 50 mm. and a lateral extent of 162 mm. Its outer extremities overlap the projecting ends of the ribs of the first costals. A band in front and at the extremities is not occupied by the sculptured layer of bone. The anterior costal bone is large, having a width at the proximal end of 67 mm. The free portions of most of the ribs project beyond the margin of the carapace at least 40 mm. The costal plates of the sixth, seventh, and eighth pairs meet along the midline. Those of the eighth pair are well developt.

Element.	Length.	Greatest Width.
Preneural.....	38	40
Neural 1.....	37	28
Neural 2.....	48	25
Neural 3.....	46	24
Neural 4.....	44	21
Neural 5.....	40	17
Neural 6.....	22	11

The sculpture of the carapace (plate 95, figs. 2, 3) consists of large, rather shallow pits, which are separated by ridges whose summits are rounded. Of these pits there are 4 or 5 in a line 20 mm. long. They are largest on the hinder half of the shell. There is only a slight tendency toward confluence into rows and furrows. On the neural bones the pits are not so distinct as on the costals.

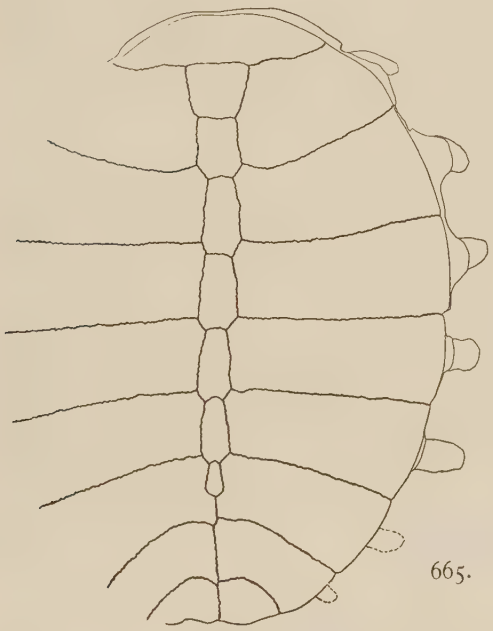
The type specimen of *A. ellipticus* was buried in a matrix of rather coarse sandstone.

A second and larger specimen of this species was collected during the summer of 1903 in the Bridger deposits of the western part of Grizzly Buttes of Wyoming. Its catalog number

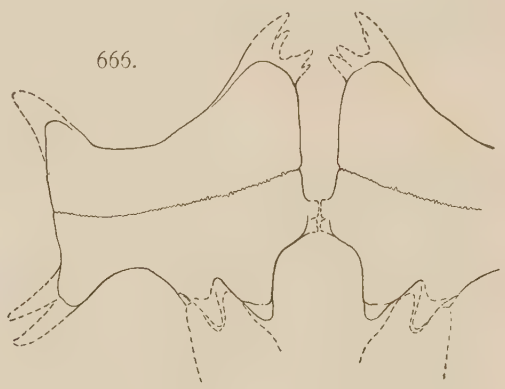
in the American Museum of Natural History is 5930. The convexity and the outline of the carapace are very similar to those of the type. The front margin is somewhat more excavated than in the type, and the lateral borders are more sinuated. This is caused by the extension of the sculptured layer out on the distal ends of the ribs.

The length of the specimen is 450 mm.; the greatest width, 380 mm. The preneural is relatively broader anteriorly than in the type, and the sixth neural is not developt. In the latter respect we may find variations in our living species of Trionychidæ.

With this specimen from Wyoming comes a considerable portion of the plastron. This includes the median half of the left and a fragment of the right hyoplastron, and a considerable part of the right hypoplastron. These bones are thick and heavy, the thickness of the bones along the suture joining them on the narrowest part of the bridge being 16 mm. From this point the thickness is reduced each way to about 10 mm. at the median and outer borders of the bones. At the narrowest part of the bridge the width of the hyoplastron is 50 mm.; of the hypoplastron, 42 mm. The xiphiplastron has joined the hypoplastron by the usual two digitations. The lower surfaces of the hyoplastra and the hypoplastra are occupied by a



665.



666.

FIGS. 665 AND 666.—*Aspideretes ellipticus.*

665. Carapace of type. $\times\frac{1}{5}$. 666. Plastron. $\times\frac{1}{6}$.

nearly obsolete sculpture of pits and ridges. This is most distinct on the outer ends of the bones, where we find 3 pits in a line of 10 mm. This sculpture and the bone supporting it have approacht nearly to the midline, an indication that the individual was an old one. The hyoplastra and hypoplastra resembled closely those of *Platypeltis ferox*, of Florida. Text-fig. 666 represents what is known of the plastron of this species. The figure is constructed partly from the specimen just described, partly from the following one.

A still larger example of this species was collected during the summer of 1903 near the mouth of Cottonwood Creek, Wyoming. Its catalog number in the American Museum of Natural History is 5979. The bones of the median line and of the left side are complete, except that the third neural is wanting and portions of the fifth, sixth, and seventh costals. Some parts of the right side are present. The right hyoplastron is quite complete.

The length of this specimen is 510 mm.; the width was close to 445 mm. It displays a greater convexity of the carapace than is seen in the other specimens. The nuchal and the preneural resemble closely those of the type. The sixth neural is present, but small. Altho the individual was so large and evidently aged, the free ends of the ribs project beyond the margin of the carapace a distance of about 40 mm. The hyoplastron is identical with that of

No. 5930. The outer anterior process was evidently flattened, not terete as usual in trionychids. The pits and ridges of the median end are quite distinctly seen. The width of the bone where narrowest is 53 mm.

The species resembles most closely *A. guttatus* (Leidy). From the latter it differs in being more elongated, the width being contained in the length seventy-six hundredths times, in *A. guttatus*, eighty-five hundredths times. The sculpture of *A. ellipticus* is coarser, there being 4 or 5 pits in a 20 mm. line, while in *A. guttatus* there are 5 or 6 pits in the same distance. The bridge of the plastron of *ellipticus* is wider relatively to the length of the hyohypoplastral suture than was *A. guttatus*. *A. guttatus* has fontanels in the front of the carapace; while *A. ellipticus* has none.

This species resembles closely the form described in this work as *A. grangeri*. The distinctive characters are discust under the latter species.

Aspideretes grangeri sp. nov.

Plate 97, fig. 1; text-fig. 667.

Among the fossils collected by Mr. Walter Granger, head of the American Museum expedition to the Bridger beds in 1904, was the fine carapace represented on plate 97, fig. 1. Only a portion of the middle region at the rear is missing. The specimen bears the catalog number 3942. It was collected on Cottonwood Creek, about half a mile below the Henry's Fork stage road. The level is given as B^3; that is, the upper portion of the middle Bridger.

The total length of the carapace (plate 97, fig. 1; text-fig. 667) was 383 mm.; the width of the disk, 317 mm.; the width to the free ends of the ribs, 343 mm. The carapace is considerably archt from side to side, the midline of the fossil rising to a height of 105 mm. above the tips of the free rib ends. In outline the carapace is broadly oval, or elliptical, slightly excavated in front, and probably slightly truncated in the rear. As in *A. ellipticus*, the upper layer of the carapace overhangs somewhat the middle layer, so that a sort of gutter runs around the edge of most of the carapace. The free border of the fifth costal plate is 7 mm. thick near the suture, and 11 mm. thick thru the rib. The nuchal has an extent from side to side of 190 mm.; a fore-and-aft extent of 40 mm. As in *A. ellipticus*, there is a smooth band along the front and the ends of the nuchal. It runs at a lower level than the pitted surface. It is about 7 mm. wide at the midline, and 23 mm. at the ends of the bone.

There are a preneural and 6 neurals. Possibly there was a seventh neural of small size. The table below gives the dimensions of these bones.

Element.	Length.	Width.
Preneural.....	26	23
Neural 1.....	39	28
Neural 2.....	46	30
Neural 3.....	44	27
Neural 4.....	43	26
Neural 5.....	38	20
Neural 6.....	29	15

At their proximal ends the costals of the first pair have a width of 59 mm. At the distal end they are only 39 mm. The next four have the proximal ends equal in width to the lengths of their respective neurals. The distal end of the costals of the second pair is expanded to a width of 88 mm. This may be an individual variation. The costals of the sixth pair probably joined each other for a part of their width at the proximal ends. Those of the next two pairs certainly joined their fellows at the midline. The lateral extent of each costal of the eighth pair was close to 36 mm. The free ends of the ribs of the median costals projected about 37 mm. beyond the border of the disk.

The sculpture of this species consists, as is usual in the family, of a network of ridges surrounding shallow pits. The ridges are rounded on their summits. On the outer third of most of the costals the pits are arranged in rows running parallel with the adjacent border of the carapace. On the nuchal, the neurals, the costals of the first pair, and the proximal two-thirds of the other costals, the pits are irregularly but evenly distributed. On the greater part of the carapace there are 5 or 6 of the pits in a line 20 mm. long. On the anterior third of the carapace there may be as many as 7 in a line of the length given. Most of the costals have a narrow smooth band along the intercostal sutures.

This species needs to be compared with *Aspideretes ellipticus* and *A. guttatus*. The form of the carapace is about the same in the three. It is broader than in the type of *A. ellipticus*, but slightly narrower than in another specimen. The preneural of the species last named is, in all the known specimens, considerably longer and broader than in the type of *A. grangeri*, while the neurals are broader. The proximal ends of the costals of the first pair are narrower in *A. grangeri* than in *A. ellipticus*, their width being contained in the length of the carapace 6.33 times in the former and only 5.5 times in the latter. The nuchal is longer, its length being contained in the length of the carapace two times; in *A. ellipticus* two and a half times. The sculpture of the carapace is coarser in *A. ellipticus* than in *A. grangeri*, there being in the former 4 or 5 pits in a line 20 mm. long while in the latter there are from 5 to 7. In making comparisons between the pits of the two species, measurements must be taken on corresponding parts of the shell; 36 measurements taken on all parts of the carapace of 2 specimens of *A. ellipticus* show that there are, on an average, 4.44 pits in a 20 mm. line; 18 measurements made on corresponding parts of the carapace of *A. grangeri* indicate an average of 5.83 pits in the distance named; that is, the pits of the former species have an average diameter of 4.5 mm. while those of the latter have an average diameter of 3.43 mm., a difference of a little more than 1 mm. In *A. ellipticus* the small pits are found almost wholly on the nuchal and close to the border of the shell toward the front. The writer regards the finer sculpture of the specimen here described as an indication of a distinct species.

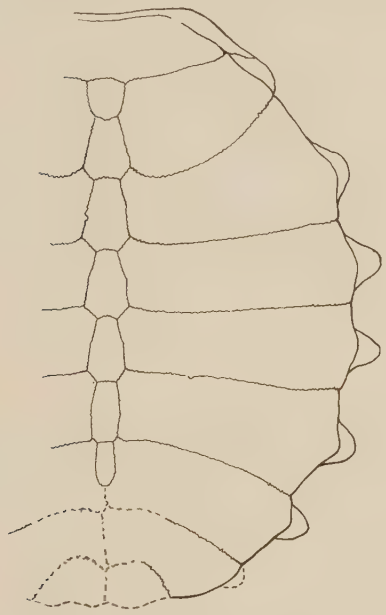


FIG. 667.—*Aspideretes grangeri*. Carapace of type. ×⅛.

The sculpture of the carapace of this supposed species is apparently identical with that of *A. guttatus* and it is possible that the specimen ought to be referred to the latter species. However, the type of *A. grangeri* has a well-developt preneural bone and no fontanel on each side of it; whereas, the specimen of *A. guttatus* has large fontanels and only a rudimentary preneural. *A. grangeri* is a strongly archt species. It is possible that the flatness of all the specimens of *A. guttatus* is due to distortion during fossilization.

Genus AXESTEMYS Hay.

Axestus, COPE, Proc. Amer. Philos. Soc., XII, 1872, p. 462. (Preoccupied in entomology.)
Axestemys, HAY, Amer. Geologist, XXIV, 1899, p. 348.

Plastron, so far as known, without the usual pits and ridges. Nuchal bone partly separated from the first costals by fontanels. Probably no preneural.

Type: *Axestus byssinus* Cope.

Professor Cope based the genus *Axestus* on the species *A. byssinus*, which was represented by the left xiphiplastron, most of the pelvis, the larger portions of both femora, both humeri with distal ends missing, the right scapula and coracoid complete, a cervical vertebra, two sacrals, a few caudals, and some phalanges. This type belongs to the U. S. National Museum, but the caudal vertebræ and the phalanges appear to have been lost.

The character on which Cope relied for separating this genus from other genera of Trionychidæ is found in the absence of superficial sculpture on the lower side of the plastron, and the presence there of a layer which "is marked with decussating lines of osseous deposits, as in woven linen." The other characters given by him in his generic descriptions are probably common to most of the Trionychidæ.

This layer of decussating bony fibers (plate 104, fig. 4) is also common to various fossil and living species of Trionychidæ, and may be seen in both the carapace and the plastron of *Platypeltis spinifera* near the borders of the bones where the sculptured layer thins out. As Cope says, such a layer is found in the dermal scutes of the Crocodilia; and Marsh has

described and figured the dermal scutes of a dinosaur, *Nodosaurus textilis*, which are markt by similar, but coarser, interwoven bony fibers.

However, since there appears to be an unusual abundance of this layer of fibers and a nearly complete absence of the sculptured layer, the so-called callosities, it appears advisable for the present, to retain the species in a distinct genus. There are reasons for believing that the nuchal bone also will offer some characters when it is completely known.

Axestemys byssina (Cope).

Plate 104, fig. 4; text-figs. 668, 669.

Axestus byssinus, COPE, Proc. Amer. Philos. Soc., XII, 1872, p. 462 (*A. bysimus*, misprint); U. S. Geol. Surv., 6th Ann. Rep., 1872 (1873), p. 616; Vert. Tert. Form. West, 1884, p. 116, plate xv, figs. 1–12.
Axestemys byssinus, HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 455; Amer. Geologist, XXXV, 1905, p. 337.

The type of this species, now in the U. S. National Museum at Washington, has been studied by the present writer. The type was found on Black's Fork of Green River; the second specimen on upper Green River. Both probably belong to level B. These bones were figured by Cope in his great work The Vertebrata of the Tertiary Formations of the West, the figures having half the size of nature. These bones are from 2.33 to 3 times as large as the corresponding ones of a specimen of *Platypeltis* whose carapace is 147 mm. long. The animal therefore had a carapace probably over 420 mm. in length.

The xiphiplastron (plate 104, fig. 4; text-fig. 668) differs from that of *Platypeltis spinifera* in having the posterior process narrower and more elongated and in having the callosity wholly devoid of the layer which ordinarily furnishes the sculpture, but composed of a layer of textile-like fibers of bony tissue. The thickness of the central portions of this bone is 10 mm., that of the living species just referred to being about 3 mm. Hence the thickness of the plastron of the fossil species under consideration is proportionally as great. The greatest length of the fragment of xiphiplastron is 166 mm. It probably had a length originally of 188 mm. The shoulder-girdle seems not to have differed in any important respect from that of *Platypeltis spinifera*. The humerus, so far as represented, is like that of the living species referred to, except that the head appears to have been more narrowly oval, with the plane thru the long axis parallel with the long axis of the shaft of the bone.

The femora are like those of *Platypeltis spinifera*, except that there is a very distinct ridge on the middle of the upper surface of the distal half of the shaft. The pelvis appears not to have offered any difference worthy of mention. The cervical vertebra which has been preserved is certainly the seventh, agreeing in every way with that of *Platypeltis spinifera*. Its centrum is just 3 times as long as that of the corresponding cervical of the specimen of *Platypeltis* referred to above.

Professor Cope mentioned another bone, a hypoplastral, which, on account of its great thickness, he thought might belong to a distinct species. This bone is now in the possession of the American Museum of Natural History and bears the number 1034. Its greatest thickness, about the middle of the bone, is 14 mm. and this is not so much greater than that of the xiphiplastron that it can not belong to the same species. The lower surface is like that of the xiphiplastron of the type. The form of this bone does not differ from that of the same bone of *Platypeltis*.

The American Museum also possesses a number of bones which include the greater portion of the left half of the nuchal, most of the left first costal, fragments of several other costals, and a fragment of plastral bone. They bear the Museum's number 1046. The nuchal bone shows conclusively that the species is not *T. scutumantiquum*, which is suggested by the character of the sculpture; while the remains of the plastron prove that they belong to *Axestemys*. The latter are thick, and hence are undoubtedly of the same species as the thick hypoplastral mentioned by Cope. Until additional materials are forthcoming we may refer them to *A. byssina*. The piece of the plastron of No. 1046 is about 8 mm. thick, near the base of one of the processes directed toward the midline, and the lower surface has the textile-like surface of the type specimen of the species. The portion of the nuchal (fig. 669) remaining has a fore-and-aft extent of 53 mm. and a total lateral extent of 102 mm. The mesial end approaches

close to the midline. Seventy-five millimeters of the front border of the bone is present. The greatest thickness of the bone is 12 mm., but most of it is thinner. The posterior half of the upper surface is ornamented with a system of well-defined and rather sharp ridges which inclose pits. Of these there are 3 or 4 in 10 mm. The anterior half of the surface was devoid of ornamentation, but is markt by numerous grooves and perforations for blood-vessels. The connection of the nuchal with the first neural and the first costal was apparently like that found in *T. puercensis*. There remains on the posterior border of the nuchal about 20 mm. of the dentated sutural edge for union with the first neural. Distad of this the border is smooth for a distance of 30 mm.; so that there have evidently existed between the nuchal and the first pair of costals two elongated fontanels, separated by the anterior neural. At the distal end of each fontanel the border turned backward, to come into contact with the costal. What the breadth antero-posteriorly of this fontanel was, we can not say, but since there appears to have been only a single neural between the first pair of costals, the fontanel was probably narrow.

The greater part of the first costal is present, only the distal extremity being gone. The average thickness is about 8 mm. The greatest fore-and-aft extent is 57 mm.; the lateral extent is a little over 100 mm., the thickness, 6 mm. The bone was originally about 125 mm. long. The anterior border for about 35 mm. proximally did not articulate with the nuchal, but formed the posterior border of the fontanel already mentioned. Distad of this, the front edge of the bone was deeply grooved for the hinder edge of the nuchal. The proximal end of

668.

669.

FIGS. 668 AND 669.—*Axestemys byssina*. $\times\frac{1}{4}$.

668. Plastron. Xiphiplastron of type; hypoplastron from No. 1034 A. M. N. H.
669. Part of nuchal and left first costal.

the bone articulated with the first neural. The direction of the proximal border shows that the anterior neural was broader at the anterior end than behind. The hinder border of the costal is jagged, for sutural union with the next costal. The rib-end of the first costal plate seems to have been overlapt by the outer end of the nuchal.

This species was a large one. The free borders of the costals were beveled off very obliquely to a sharp edge and on this beveled surface decussating bony fibers, like those of the plastron, are seen in abundance. How far the free portion of the ribs extended beyond the border of the carapace can not be determined, but the distance must have been considerable.

The sculpture of the costals resembled that of the nuchal; but, in places at least, the pits are larger and the ridges sharper. The walls slope away gradually toward the bottom of the pits. There is little or no tendency toward the arrangement of the pits in rows.

There appears to be sufficient reason for believing that the plastral and the carapacial bones here described belonged to the same individual.

Genus AMYDA Oken.

Carapace normally with 8 pairs of costal plates. No preneural present. One or more of the posterior pairs of costals may be in contact on the midline, or all may be separated by the neurals. Young in living forms with numerous longitudinal dorsal dermal ridges or series of tubercles.

Type: *Trionyx euphraticus* Daudin.

The living species included by the present writer under this genus are those embraced under the heads 1, A and 1, B, 2 and 3, of Dr. Boulenger's synopsis of species, on page 244 of his Catalogue of Chelonians. The type of the genus is *Trionyx euphraticus* of the same work. It is possible that *Trionyx subplanus* Geoffr. ought to be regarded as the type of the genus *Dogania*. Besides the fossil North American species whose remains are complete enough to prove that they belong under the present genus, a considerable number of others are placed here provisionally.

For a discussion of the name *Amyda* see Stejneger, Science, XXI, 1905, page 228.

As remarkt under the genus *Aspideretes* it seems most probable that the upper Cretaceous species placed here under *Amyda* really belong under *Aspideretes*.

KEY TO NORTH AMERICAN SPECIES OF AMYDA.

A^1. Upper Cretaceous species:
1. Sculpture coarse, mostly of circular pits, about 4 in line of 16 mm..... *prisca*
2. Sculpture still coarser; 3 pits in line 15 mm. long; pits deep, rising gradually to summit of wall..... *halophila*

A^2. Species of Atlantic slope Eocene:
1. Middle of costal with irregular pits, the sutural borders with ridges somewhat oblique to the borders; about 2 ridges in a 10 mm. line..... *pennata*
2. Costals much thicker than in *pennata;* pits and ridges coarse as in *pennata* but irregular or in rows at right angles with the sutural borders..... *virginiana*

A^3. Wasatch species:
1. Costals thick and growing thicker toward outer end; sculpture coarse; irregularly arranged and deeply imprest pits; 4 or 5 in line 20 mm. long..... *cariosa*
2. Costals thick; sculpture mostly of winding and anastomosing ridges inclosing pits and short furrows; 2 or 3 ridges crost by line of 5 mm..... *ventricosa*
3. Costal bones thinner than in *cariosa;* the sculpture similar..... *radula*

A^4. Bridger species:
1. Carapace nearly as wide as long; front of nuchal long and nearly straight; with a smooth band in front; 5 or 6 pits in 20 mm..... *æqua*
2. Carapace nearly as broad as long; 4 to 7 pits, usually 5, in 20 mm. line; no depression along back; nuchal, from side to side, 0.64 the width of the shell..... *uintaënsis*
3. Carapace nearly as wide as long; a conspicuous depression along the back; length of nuchal 0.80 of width of shell; with a smooth band in front..... *scutumantiquum*
4. Costal bones thin; on proximal ends of costals, 2 pits in 10 mm.; on distal ends, 3 or 4; some ridges crossing the costals more conspicuous than others..... *concentrica*
5. Carapace nearly as broad as long; nuchal not half as wide as carapace; sculpture of median coarseness, 3 pits in 10 mm..... *franciscæ*
6. Carapace broader than long; nuchal nearly 0.6 the width of the carapace; sculpture coarse and irregular, on central portions from 2 to 5 pits in 20 mm.. *salebrosa*
7. Carapace about as broad as long; the bones thin; nuchal concave in front, its length nearly 0.7 the width of the carapace; a smooth band along its front; sculpture coarse, about 2 pits in 10 mm. line..... *exquisita*
8. Carapace nearly as broad as long; rounded in front and behind; nuchal a little more than half the width of the carapace; on proximal ends of costals, 3 pits in 15 mm., on neurals and on distal ends of costals 5 or 6 pits in 15 mm. line.. *mira*
9. Known only from skull, which resembles that of *A. ferox;* crushing surfaces of upper jaw broad..... *tritor*
10. Carapace nearly as broad as long; nuchal not one-half the width of the carapace; sculpture coarse, 3 or 4 pits in 20 mm. line..... *egregia*

A^5. Uinta species:
1. Carapace broadly oval; nuchal 0.65 the width of the carapace; sculpture coarse, 1 or 2 pits in 10 mm. line..... *crassa*

A^6. Miocene species:
1. Costals thick and heavy; crost by narrow, sharp ridges, like those of a file, 2 in about 7 mm..... *lima*
2. Costals not so thick; ridges closer together than in *lima* and curving across costal *buiei*
3. Pits of costals closely placed, irregular in size and remarkably deep..... *cellulosa*

Amyda? prisca Leidy.

Plate 97, figs. 2–6.

Trionyx priscus, LEIDY, Proc. Acad. Nat. Sci. Phila. 1851, p. 329; Smithson. Cont. Knowl., XIV, 1869, art. vi, pp. 113, 120, plate xviii, fig. 9.—COPE, Cook's Geol. N. J., 1868, (1869), p. 735; Proc. Acad. Nat. Sci. Phila. 1869, p. 12; Trans. Amer. Philos. Soc., XIV, 1869, pp. 151, 153; Vert. Cret. Form. West, 1875, p. 260.—MAACK, Palæontogr., XVIII, 1869, p. 281.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

The original description of this species given by Dr. Leidy was exceedingly brief, presenting merely the thickness of the fragment of costal plate on which the species was founded, and the statement that it was derived from the Cretaceous greensand of New Jersey. Cope's first mention of it, cited above, gives only the name; the second a description included in two lines; the third, the name and the information that it came from the greensand of New Jersey; the fourth, that it was derived from the greensand No. 4, by which he meant the equivalent of the Pierre beds of the West.

Maack merely refers to the species and says that it was the only form of *Trionyx* then known from the Cretaceous.

In 1869 Dr. Leidy, as cited above, gave a detailed description and a figure of a characteristic specimen. This specimen must be regarded as the type. It was found in the marl on the farm of G. C. Schenck, in Monmouth County, New Jersey, and was sent to Dr. Leidy by Professor Cook, then state geologist of that state. This type is now in the state collection at Rutgers College, New Brunswick, New Jersey, where it has been examined by the writer. Leidy's figure of the specimen is reverst, but otherwise correct. The pits are abruptly sunken and the ridges are flat. Pits and ridges are both smaller as the free border is approacht. In the middle of the length of the fragment there are 4 ridges in a line 16 mm. long.

Professor Cope states (Trans. Amer. Philos. Soc., XIV, p. 152) that the costal plate mentioned by Leidy as coming from the greensand of Burlington County, New Jersey, and now in the collection of the Academy at Philadelphia, belongs to *A. halophila* (Cope).

In the Cope collection of reptiles at the American Museum of Natural History there are about a dozen fragments of the carapace, 2 or 3 of the plastron, the distal end of the left humerus, and a posterior dorsal vertebral centrum. These specimens are credited to Dr. C. Schenck, Marlboro, Monmouth County, New Jersey, probably the collector of Leidy's specimens. The number of the lot is 2401, and it is probable that it represents more than one individual. These fragments were identified and labeled by Cope as *Trionyx priscus*. Figures of some of these parts are here presented. Fig. 2, plate 97, represents the upper end of a costal plate, the portion in immediate contact with the neural plate being broken off. The width at the middle of the piece is 28 mm.; the thickness at the sutural border is 7 mm.; and that thru the middle of the width is 8 mm. Fig. 3 of the same plate shows the distal end of a costal bone, but no sutural edge is retained. The thickness near one sutural border is 7 mm., while thru the elevation produced by the rib the thickness is 11 mm. The rib projected beyond the border of the costal plate, but how far can not be determined. The free edge of the costal plate is abruptly rounded off in section. The fragment resembles greatly the border portion figured by Leidy, and this author's figure shows that the rib projected nearly 20 mm. beyond the costal plate. Leidy regarded the costal which he figured as belonging to the left side, but it seems rather to belong to the right. Fig. 4 of the plate referred to appears to be a portion of the nuchal; but if so, this fragment did not extend to the midline nor show the distal end of the bone. It indicates that there was a median excavation in the front of the carapace, and a fontanel between the nuchal and the first costal plate. The bone is only 5 mm. thick, while in front of the sculptured surface there is a smooth band. Fig. 5 of the plate represents what appears to be the distal end of the hindermost costal plate of the right side. The sutural border is present in front. The projecting rib is broken off just after leaving the plate. The bone is 8 mm. thick and the free edge is cut off rather abruptly in section. Fig. 6 is a portion of one costal, probably from the middle of the length. The shorter of the two longer borders shows the suture.

The two fragments of the plastron afford but little light regarding its structure. It appears to have been 11 mm. thick where the hyoplastron and hypoplastron are constricted between the legs of the animal.

The sculpture of the carapace is coarse, and consists of deep pits of rather regular size, surrounded by walls which are as wide as the pits themselves. The figures of plate 97 show the general character of the ornamentation. The ridges which run across the costal plates are strongly developt, while the connecting ridges are less prominent. There are four rows of pits in about 15 mm. The sides of the pits rise more abruptly and the summits of the ridges are broader and more rounded than in *A. halophila*. On the proximal ends of the costal plates, as shown by fig. 2, plate 97, the pits are arranged irregularly and vary much in size.

The pits of the fragments of the plastron are smaller than those of the carapace and not so deep.

Until more of the carapace of this species shall have been secured, we shall be uncertain as to its generic position.

Amyda? halophila (Cope).

Plate 96, figs. 4, 5.

Trionyx halophilus, COPE, Proc. Acad. Nat. Sci. Phila. 1869, p. 12; Cook's Report Geol. New Jersey, 1868 (1869), Append. B, p. 735; Trans. Amer. Philos. Soc., XIV, 1869, p. 151, plate vii, fig. 15; Vert. Cret. Form. West, 1875, p. 261.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

This species is said by Professor Cope to have been founded on numerous portions of the carapace and plastron, some from near Summit Bridge, New Castle County, Delaware, and some from Camden County, New Jersey. Whether or not these represented more than two individuals we are not informed. In the Cope collection of reptiles in the American Museum of Natural History there is a lot of bones, No. 1476, consisting of about 35 fragments of costals, neurals, and at least 1 piece of the plastron. With these is found Cope's label, as follows: "*Trionyx halophilus* Cope. Type spec. Pits of Benj. Biggs, Summit Bridge, New Castle County, Del., 1867." In George H. Cook's Geology of New Jersey, p. 734, Cope states that in New Jersey this species comes from the lower marl bed of the Cretaceous.

It is difficult to determine what meaning to attach to Cope's use of the terms "No. 1," "No. 2," etc., in his table of measurements on page 152, of the Transactions American Philosophical Society, as cited above. It may mean that he had portions of 5 individuals, which is the more probable conclusion. He speaks of having one costal plate which retained a portion of the head of one rib, and in the measurements he mentions it as "costal plate No. 1." This fragment is yet in the collection, and is the one figured by him; but it is not the first costal. His "centrum vertebra No. 2" is also present, but the shortness of the neural plate attacht to it, only 27 mm., appears to indicate that it is one of the posterior neurals.

This species was a rather large one, the length of the carapace of the individual, or individuals, represented by the remains before us, having probably been about 275 mm. The larger fragments of costal plates indicate that the carapace was considerably archt from side to side. The shell was quite thick and heavy; and the ribs stood out prominently on the under side of the distal ends of the costal plates. The thickness at the sutural border, at the outer end of one costal is 8 mm., while thru the rib it is 15 mm. The width of the costal at the outer end was at least 56 mm. On plate 96, fig. 4, is represented of the natural size a neural plate and a portion of a costal which belonged together. They are the same bones that Cope has figured. The greatest length of the neural is 37 mm.; the greatest width, 35 mm.; the thickness, 8 mm. The length of the fragment of costal is 60 mm.; its width, 38 mm.; its thickness, at the costal margin, 7 mm.; at the middle of the width, 9 mm. The inner surface displays the base of the rib-head. Cope states that his figure is half the natural size but, while the length of the figure of the piece of costal is slightly more than half the size of the original, the dimensions of the other portions are three-fifths of their natural size. Fig. 5 of plate 96 represents a portion from the middle of the length of a costal plate. The right and left sides of the figure are the sutural borders.

The neural plate which surmounts the centrum spoken of by Cope as "No. 2" is damaged somewhat, but it has had a length, in the midline, of 25 mm. and a width of 28 mm. The posterior border is convex, the anterior concave.

The slight evidence afforded by one costal indicates that the free border was rounded off in section. The rib projected somewhat beyond the edge of the plate.

The sculpture of this species is peculiar. It consists of rather large pits of quite regular size and form. They are rather deep, and from the bottom of each the surface rises gradually to the top of the wall surrounding them, thus being bowl-shaped. In *A. prisca* (Leidy) and some other species, the wall around the pit is more abrupt. Usually three pits occupy a line of 15 mm. On the small portion of the plastron referred to, the pits are only about half as large as those of the carapace, and are much shallower.

Among the fragments supposed to belong to this species is one which seems to have formed a portion of the nuchal. If this identification is correct, this bone was rather thin where it joined the first neural and first costals, but very thick, 11 mm., near the anterior border. The free border was rounded in transverse section. At the midline this bone was only about 22 mm. wide fore and aft, but it widened rapidly, being 38 mm. wide at a distance of about 40 mm. from the midline. Thus the carapace appears to have been deeply and broadly excavated in front. There is present a piece of some portion of the plastron. It is probably the bone which Cope regarded as a part of the xiphiplastron. It has a thickness of 13 mm.

There is in the Philadelphia Academy's collection a fragment of a costal plate which is to be referred to this species. It was found at Camden, New Jersey. This fragment is 38 mm. wide and represents about half the width of the costal. The thickness at the sutural border is 10 mm.; thru the ridge formed by the rib, 12 mm. There are 4 pits in a line 20 mm. long.

Cope thought that this and some of the other species of Trionychidæ were inhabitants of the sea, and he refers to a statement of Du Chaillu to the effect that *Amyda triunguis* had been found at sea. The fact may be mentioned that there is in the American Museum of Natural History a specimen of *Amyda sinensis* (Wiegm.) which was captured in 1902, by Mr. N. G. Buxton in Vladovostock Harbor, Siberia.

Amyda? pennata (Cope).

Plate 96, fig. 6.

Trionyx pennatus, Cope, Proc. Acad. Nat. Sci. Phila. 1869, p. 12; Cook's Report on Geol. New Jersey, Append. B, 1868 (1869), p. 734; Trans. Amer. Philos. Soc., XIV, 1869, pp. 151, 152, plate vii, fig. 13.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

As in the case of too many of our fossil tortoises, our knowledge of this species is meager. The species was based on a portion of the distal end of a costal bone, which was found in the upper, or Eocene, bed of greensand, probably near Squankum, Monmouth County, New Jersey, by Mr. O. B. Kinne. The specimen is now a part of the Cope collection of reptiles in the American Museum of Natural History, and bears the number 1165. Cope, as cited, figured the type half the natural size. On plate 96, fig. 6, of the present work, it is represented of the natural size.

The fragment is supposed to include a little more than two-thirds the width of the distal end of the costal, unless the rib lay nearer one sutural border than to the other. The costal had, therefore, probably a width of about 60 mm. On the left of the bone, 47 mm. of the sutural border is shown. At the proximal end of this border, the thickness is 7 mm. At the distal end it is 10 mm. Where the rib left the costal plate, the thickness is 13 mm. The free border of the costal is cut off at a right angle with the upper surface.

The sculpture is of a coarse pattern. The ridges are broad and rounded, but the diameter is usually less than that of the intervening furrows. In the type, the ridges run from the sutural border of the bone inward and somewhat toward the distal end, and this arrangement evidently suggested the name *pennatus*. Soon there appear connecting ridges and the furrows become broken up into large and small pits. Near the border there are 2 furrows in 10 mm. Many of the pits in the median portion of the costal are of less diameter than the surrounding walls.

Besides the type, there is now in the American Museum a fragment of a costal, No. 2221, which belongs to this species. The bone shows 67 mm. of one sutural border and 8 mm. of the one opposite. The width of the bone was 44 mm. The thickness of the sutural border at one end is 7 mm.; at the other, 9 mm.; thru the rib, 12 mm. In this fragment the principal ridges of the ornamentation run at nearly right angles with the sutural borders, while the pits are very irregular in form and size.

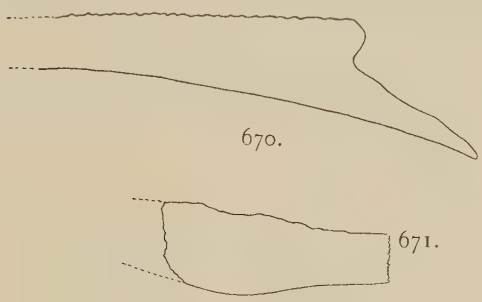
At what locality this specimen was collected there is no information; but it is very certain that it was obtained in the greensand of New Jersey.

Amyda? virginiana (Clark).

Plate 96, figs. 7, 8; text-figs. 670, 671.

Trionyx virginianus, CLARK, Johns Hopkins Univ. Bull., XV, 1895, p. 4; Bull. No. 141, U. S. Geol. Surv., 1896, p. 59, plate viii, figs. 1*a*, 1*b*.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 455;—CASE, Maryland Geol. Surv., Eocene, 1901, p. 97, plate xi, figs. 1, 2.

All the known specimens of the present species were found at Aquia Creek, Virginia, in Eocene deposits belonging to the Aquia Creek stage. The type fragments consist of a portion of the distal end of a costal plate and of what appears to be the proximal end of another costal, but which is possibly the outer end of the left hypoplastron.



FIGS. 670 AND 671.—*Amyda? virginiana*. Sections of costal bones of type. $\times\frac{1}{2}$.

670. Section parallel with intercostal suture.
671. Section at right angle with intercostal suture.

The first-mentioned fragment represents about half of the width of the costal. Figure 670 shows a section along the broken edge, the distal end being toward the right. At the proximal end the fragment is 17 mm. thick. Toward the distal end this increases to 26 mm., then drops off suddenly to half the latter thickness, then runs out to a thin edge. At the sutural border the thickness is slightly greater than at opposite points on the broken border. This shows that there is no ridge produced by the rib. The sculpture (plate 96, fig. 7) consists of ridges and grooves placed at right angles with the sutural border. There are a few ridges crossing the grooves, breaking them up into circular and elongated pits. Five pits and as many ridges are found in a line 22 mm. long. Toward the line where the thickness is suddenly reduced the sculpture becomes obscure. There is no smooth band along the sutural border.

The pits of this costal have the same size as in *A. pennata* (Cope), of the Eocene of New Jersey. However, in the latter the pits are arranged in rows that run from the sutural edges toward the middle of the bone and at the same time toward the distal end. In *A. pennata* the rib produces a decided thickening on the under side of the distal end of the costal.

The second piece (plate 96, fig. 8) of the type of *A. virginiana* (Clark, fig. 1*b*) has a thickness of 13 mm. at the distal end of the bone, increasing toward the other end to 15 mm. Fig. 671 is a section across this bone. From the sutural border the bone increases to 22 mm. thickness, an increase due to the presence of the rib on the under side of the bone. This costal plate appears to have been about 80 mm. wide. An objection to regarding this fragment as the outer end of the left hypoplastron is the fact that the ridge runs parallel with the sutural border, instead of approaching it in one direction.

The sculpture of this fragment differs from that of the other in having the ridges considerably broken up and quite irregular in direction. The pits are slightly larger, there being 5 of them in a line 25 mm. long. Along the sutural border there is a band 15 mm. wide which is markt only by striations at right angles with the sutural edge. It is possible that in these two fragments we have two distinct species.

Amyda? cariosa (Cope).

Plate 86, figs. 9, 10.

Trionyx cariosus, COPE, Syst. Catalogue Vert. Eocene, New Mexico, 1875, p. 35; Ann. Rept. Chief of Engineers, 1875, p. 1025 (of *separata*, p. 95); Wheeler's Surv. W. 100th Merid., 1877, p. 44, plate xxvi, figs. 5–10; Vert. Tert. Form. West, 1884, p. 118.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 453.

The type specimens of this species are in the U. S. National Museum at Washington, and have the catalog number 2575. Those which Cope figured consist of fragments of costal bones, 1 neural, and a supposed xiphiplastral. Cope mentions also a hypoplastral as being among his materials. The species is characterized by the coarse sculpture, the thickness of the bones, and the longitudinal grooving of the margins of the carapace. The type was found in the Wasatch beds of New Mexico, by Professor Cope, in 1874, along the Gallinas River.

As regards the thickness, Cope states that one costal was 7 mm. thick at the proximal end, and that others were 11 mm. and 12 mm. thick at the middle of the length and at the distal ends. At the free margins of the costals the upper layer of bone projected far beyond the lower layers, causing, as Cope states, a deep longitudinal grooving of the free border of the carapace. The costals had a width of about 45 mm. at the proximal end and of about 60 mm. at the distal end. In Cope's figures the width of the ridges is exaggerated and the pits are made to appear too abruptly sunken.

The figures publisht by Cope show that there are on the proximal ends of the costals deeply imprest and irregularly arranged pits, of which there are four or five in a line 20 mm. long. Along the sutural borders of each of the costals there is a smooth strip. More distally the pits arrange themselves in irregular rows, and sometimes coalesce to form furrows, which run parallel with the margin of the carapace. Of these there are about three in 20 mm. In Cope's figure 7 the ridges and furrows are not represented with enough distinctness. On the neurals there was a honeycomb of pits similar to those on the adjacent ends of the costals. Cope says that the hypoplastron in his possession presented a rather irregular reticulate sculpture medially. The element figured as a probable xiphiplastron had a patch of large pits; but this bone is really the left extremity of the nuchal. The figure is inverted. The right extremity of the nuchal is present likewise.

Fig. 9, plate 86, reproduced from Cope, gives a view, natural size, of a portion of a neural bone, while fig. 10 of same plate shows a fragment of a costal plate.

A. radula has a style of ornamentation quite similar to that of the present species; but the shell is thinner, and the free margins are beveled off, instead of having the upper layer of bone overhanging the lower layers.

Amyda? ventricosa (Cope).

Plate 98, figs. 1–6.

Trionyx ventricosus, Cope, Extinct Vert. New Mexico, in Wheeler's Surv. W. 100th Merid., IV, 1877, p. 45; plate lxiv, figs. 7–13; Vert. Tert. Form. West, 1884, pp. 118, 188.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 455.

This species is represented by somewhat more than 25 fragments, which Cope states belong to 3 individuals. Of these fragments, 7 are figured in Cope's work in the Wheeler Survey, as cited above. All these specimens belong to the U. S. National Museum and bear the number 1112. Of the pieces figured by Cope, all are present, except the one which furnisht fig. 10 of the plate cited. New figures of these are here furnisht, except of the missing fragment.

This species was found by Cope in the year 1874, in the Wasatch deposits of Rio Arriba County, New Mexico.

Fig. 1 of plate 98 (Cope's fig. 13) represents the distal end of the left hypoplastron. This bone indicates that the width of the hypoplastron at the narrowest portion was 20 mm., and that the various dimensions of at least the distal end of the bone were about as they are in *Platypeltis spinifera*. Cope states that the "twin gomphosial processes" were short and stout but these are not figured, and probably were not present on any of the specimens when found. The processes referred to separated from each other before they left the edge of the "callosities," and hence were probably short. The thickness of the bone where these processes part is 10 mm.; at the sutural edge for union with the hyoplastron the thickness is 7 mm. The ornamentation consists of narrow ridges which, near the free border of the bone, curve around mostly parallel with these free borders; elsewhere, they are irregular in their course. These ridges are frequently connected by cross-ridges, and the intervening spaces form pits and short furrows wider than the ridges. Usually there are 2 or 3 pits in a space of about 5 mm.

Fig. 2 of plate 98 (fig. 12 of Cope) presents the same part as the previous figure, but of another individual; but it offers no peculiar features. The same bone of a third individual was larger, the thickness at the base of the twin processes being 14 mm. Fig. 3 of the same plate (fig. 11 of Cope) is a fragment undetermined as to position, but probably belonging to the plastron. It is about 7 mm. thick. The ridges and pits of the sculpture have no regular arrangement, and the sculpture turns over the edge just below the outstanding process on one side. Fig. 4, plate 98 (fig. 7 of Cope), shows the distal end of a costal plate, including the

sutural edge on one side. At the junction of the sutural border with the free border, the thickness is 10 mm. On the sutural border, at the end of the fragment toward the midline, the thickness is reduced to 8 mm.; that is, this costal is thicker at the outer end than nearer the midline. This and other fragments show that the free edge, on each side of the rib extension, was cut off at nearly right angles with the sculptured surface. The sculpture came down close to the distal ends of the costal plates. In some cases, but not all, there is a tendency for the pits to arrange themselves, at the ends of the costals, somewhat parallel with the free border of the bone.

Fig. 5 (fig. 9 of Cope) is a portion of the costal plate of a small individual. The width is 21 mm.; the thickness, only 4 mm. Fig. 6 (fig. 8 of Cope) represents a fragment from probably the proximal end of a costal plate. Here the ornamentation consists of tubercles and short, winding, and occasionally anastomosing, ridges, the pattern being somewhat coarser than that of the plastron, there being two furrows or pits in about 5 mm. This is true of most of the ornamentation of the carapace.

Amyda radula (Cope).

Plate 86, figs. 11, 12.

Trionyx radulus, Cope, Systematic Cat. Vert. Eocene New Mexico, 1875, p. 35; Report on Geol. N. W. N. Mex., in Appendix Ann. Rep. Chief of Engineers, 1875, p. 1015 (of *separata*, p. 95); Wheeler's Surv. W. 100th Merid., IV, 1877, p. 45, plate xxvi, figs. 11–16.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

In his original description Professor Cope characterized with great brevity this species of *Amyda*. In his final report on his explorations in New Mexico, publisht in the fourth volume of the Wheeler Survey, he gave some additional data and figures of some of the fragments on which he had based the species. Even here, however, the description is limited to 10 lines of print. The type specimens are now in the U. S. National Museum, at Washington, No. 2581. They were collected in Wasatch deposits along the Gallinas River, New Mexico.

The figures given by Professor Cope make the summits of the ridges surrounding the pits appear too broad. They are really narrow. From their summits the walls slope rapidly to the bottoms of the pits, but not so abruptly as the figures indicate.

Cope's fig. 11 represents the distal end of a costal. It has a thickness of 6 mm. In the original of fig. 13 the free border, at the side of the extension of the rib, is cut off nearly square, with a tendency of the upper layer to overhang. It will be observed that the sculpture of this and of the costal of his fig. 14 (plate 86, fig. 11) comes down close to the free border of the bones. Cope's fig. 15 (plate 86, fig. 12) represents the middle of a costal. The sutural border is 4 mm. thick. There are 6 pits in a line 20 mm. long. His fig. 16 is that of a neural which has a thickness of 6 mm.; and there are 5 pits in a line 15 mm. long. In these specimens the rib does not stand out prominently on the under side of the costal.

Cope (Vert. Tert. Form. West, p. 119) identified with this species some portions of a carapace found in the Bridger beds. This is here described under *Amyda æqua*. For a discussion of the relationships of the Wasatch species and the closely related *A. æqua* of the Bridger see under the latter. It is greatly to be desired that additional materials of *A. radula* from the type locality shall soon be discovered and described.

A. radula has the sculpture similar to that of *A. cariosa*. The two appear to be distinguisht by the greater thickness of the shell of the latter and the groove around its free margin.

Amyda æqua sp. nov.

Plate 99, figs. 1–3; text-figs. 672, 673.

Trionyx radulus, Cope, Vert. Tert. Form. West, 1884, p. 119.
Amyda radulus, Hay, Amer. Geologist, xxxv, 1905, p. 336.

In the work above cited Professor Cope described and referred to his *Trionyx radulus*, of the Wasatch of New Mexico, some remains of a trionychid which he found in the Bridger beds of Wyoming. This Bridger individual now belongs to the American Museum of Natural History and has the number 1052.

The nuchal is now 280 mm. long from side to side, and it was originally perhaps nearly 300 mm. The fore-and-aft measurement in the midline is 45 mm. It narrows toward the outer ends. The anterior margin is nearly straight, and the bone is 12 mm. thick in most of its parts. The anterior portion of the upper surface is occupied by a smooth band running from the one extremity to the other. The outer ends of the costal plates are ornamented with pits and furrows varying from 2 mm. in diameter near the free border to 5 mm. away from the border. These are arranged mostly in rows parallel with the free border of the costal. Elsewhere the pits are irregularly distributed.

In 1902, Dr. W. D. Matthew and Mr. Walter Granger, employed by the U. S. Geological Survey, collected at Opal, Wyoming, two nearly complete carapaces of a trionychid which is without doubt identical with Cope's Bridger specimen. These deposits at Opal belong to the lowest of the Bridger formation. Fig. 1, plate 99, shows the form of the better specimen. A study of these and a specimen obtained for the American Museum of Natural History by Messrs. Granger and Sinclair, in 1905, have convinct the writer that it is better to describe them under a new name than to follow Cope's example of assigning them to *A. radula*, a species from the Wasatch.

This was an exceedingly large turtle, the length of the better carapace from Opal (plate 99, fig. 1; text-fig. 672), along the midline, being 431 mm. and the width, greatest slightly behind the middle of the length, 400 mm., not including the extension of the ribs beyond the border of the shell. The carapace was only slightly convex, with a slight longitudinal depression in the central portions. Anteriorly and posteriorly the carapace is truncated, with the result of making it appear nearly square. The anterior border of the nuchal bone is especially straight. Its size and appearance is almost identical with that of Cope's Bridger specimen and needs not to be described. Its distal ends lie above the contiguous parts of the first costals; and there are no fontanels behind the nuchal. There are eight neural plates, there being one which appears to belong to the eighth pair of neurals, an unusual thing. Of these, the first is the largest and the eighth the smallest. A view of the figure will show that there exist various irregularities in the forms of the neurals and costals. The first neural has a length of 70 mm. and a width of 55 mm.; but the second specimen has a smaller neural, the anterior end of which is not so broad as the posterior. The third neural of the large specimen is 50 mm. long and 39 mm. wide.

It will be observed that the seventh neural is heart-shaped and is brought forward so as to lie partly between the costals of the sixth pair. The eighth neural is very small, 12 mm. long and 19 mm. wide, and lies between the seventh costals. The eighth pair of costals measure fore and aft, 44 mm. and from side to side, taken together, 136 mm. As an individual peculiarity, the right one is much the larger.

The borders of the shell are beveled off obliquely at the sides, and nowhere does the superficial layer overhang the ribs. Posteriorly the edge of the shell is rounded. The ribs project beyond the shell about 30 mm., and these projecting ends are 25 mm. or more wide. At their sutural borders the costal plates are about 8 mm. thick.

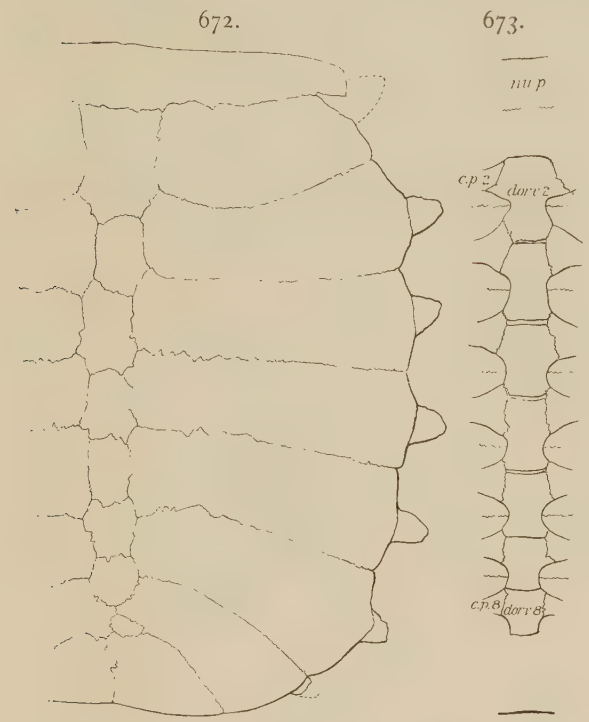
As stated, there is a smooth band along the front of the nuchal bone. In the central portions of the shell (plate 99, fig. 2) the ornamentation consists of large shallow pits surrounded with a low narrow wall. Here the pits average about 5 mm. in diameter. As the outer ends of the costals (same plate, fig. 3) are approacht, the pits become slightly smaller and are arranged more or less in rows which are parallel with the free border of the costal. There may be as many as six pits in a line 20 mm. long. Here also the walls show a tendency to break up into short ridges and tubercles. At the end of the plates there is a smooth band from 18 to 25 mm. wide.

The vertebral column is strongly developt, as shown by fig. 673.

The second specimen, from Opal, is greatly like the one just described; but the greatest width is slightly further forward and the hinder border is not so squarely truncated.

The specimen collected by Messrs. Granger and Sinclair at the mouth of Big Sandy Creek, Wyoming, No. 3938 of the American Museum, resembles in essential particulars the carapaces just described, but it appears even flatter than these. The length is 450 mm., the breadth, 370 mm. The ribs projected beyond the free margins at least 30 mm. There is a broad smooth band around the border, except in the rear. The ridges surrounding

the pits are broad and rounded. The pits measure as in the Opal specimens. Usually there are 5 of them in a line 20 mm. long, but sometimes as many as 6 and again as few as 4. The thickness of the second neural is 8 mm.; that of the sutural border of the second costal, near the distal end, 7 mm.; that thru the middle of the width of the same costal, 13 mm.



FIGS. 672 AND 673.—*Amyda æqua*. Carapace of type. × $\frac{1}{5}$.

672. Carapace.
673. Vertebræ of carapace, seen from below. *c.p.* 2, *c.p.* 8, rib-heads of second, and eighth costal plates; *dor.v.* 2, *dor.v.* 8, second and eighth dorsal vertebræ; *nu.p.*, nuchal plate.

Too little is known regarding Cope's *Trionyx radulus*, originally found in the Wasatch beds of New Mexico, to identify the Bridger specimens as the same. In the Wasatch specimens the smooth beveled band around the free border is much narrower than in the Bridger carapaces, the ridges of the sculpturing coming down in places close to the edge. In the case of the costal of Cope's fig. 13 the border near the projecting rib is cut off nearly square, with a tendency of the upper layer to overhang. Nothing of this sort is seen in any of the Bridger specimens. The costals and the neurals of the Bridger forms appear to be thicker than those of the type of *A. radula*. The pits of the latter, too, are smaller, there being usually 6 in a 20 mm. line, instead of 5. The ribs of *A. radula* do not stand out so prominently on the under side of the costals as they do in the specimens of *A. æqua*.

The specimen (plate 99) belonging to the U. S. National Museum is taken as the type of *A. æqua*.

Amyda uintaënsis (Leidy).

Plate 100, fig. 1; text-figs, 674, 675.

Trionyx uintaënsis, LEIDY, Proc. Acad. Nat. Sci. Phila. 1872, p. 267; Contrib. Ext. Vert. Fauna West. Terrs., 1873, pp. 178, 342, plate xxix, fig. 1.—COPE, Vert. Tert. Form. West. 1884, p. 118; Contrib. Canad. Palæont., II, 1891, p. 5.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.
Amyda uintaënsis, HAY, Amer. Geologist, XXXV, 1905, p. 336.

The present species was based on a nearly complete carapace which was procured by Dr. Leidy during his stay at Fort Bridger, in the year 1872. It was found, it is stated, in the Bridger deposits, at Dry Creek, about 10 miles from Fort Bridger. It is probable that Little Dry Creek was meant. If so, the level is B. This specimen belongs to the Academy of Natural Sciences of Philadelphia, where the writer has been permitted to study it. Originally little more than fragments were missing from the right side, altho the left side was more damaged. Now, however, it lacks the nuchal, which was originally present. The specimen was kindly loaned to the writer with permission to develop it further, and the result has been to find present most of the plastron and some of the cervical vertebræ.

Neural.	Length.	Width.
1	58	33
2	46	31
3	46	27
4	42	21
5	38	25
6	24	23

The carapace (fig. 674) is nearly as broad as long, broadest somewhat behind the middle of the length, very slightly concave in outline near the middle of the front, sinuous along the sides, and truncated behind. As stated by Dr. Leidy, the carapace is about as convex as that of *Platypeltis mutica*. The length

is 420 mm. and the maximum width 394 mm. There are 8 pairs of costal plates and 6 neurals. The nuchal extended from side to side 240 mm., and from front to back 56 mm. There is no fontanel behind the nuchal. The neurals are, in general, rather narrow. The anterior two are coffin-shaped, with the narrow end directed forward; the next two are nearly quadrilateral; the fifth coffin-shaped, with the broad end forward, while the sixth is cordate and much reduced in size. The table presents the length and the maximum breadth of the neurals.

Of the costal plates, the first is broader than any of the others at the proximal end. The second and the sixth are wider than any others at the distal end. The eighth is very short in all directions. On account of the absence of the seventh and eighth neurals and the reduction of the sixth, the three hindermost pairs of costals meet in the midline. The rib of the fourth right costal is present and projects beyond the border of the costal about 30 mm., being 28 mm. wide at the base. Similar ribs have extended beyond the other costal plates, except the seventh and the eighth. The costal plates are about 5 mm. thick.

The sculpture resembles that of *Aspideretes guttatus* but is coarser. There are from 4 to 7 pits in 20 mm., usually five, the pits being quite irregular in size and grouping. From their summits the walls between the pits slope gradually to the bottoms of the latter.

FIGS. 674 AND 675.—*Amyda uintaënsis*. Carapace and plastron of type. $\times \frac{1}{5}$.

674. Carapace.

675. Plastron. *cer.v.* 6, *cer.v.* 8, sixth and eighth cervical vertebræ; *ent*, entoplastron; *l.epi*, *r.epi*, left and right epiplastron; *l.hyo*, *r.hyo*, left and right hyoplastron; *r.hypo*, right hypoplastron.

The hyoplastron and the hypoplastron of the right side are complete, excepting that the extremities of the external processes are broken away (plate 100, fig. 1; text-fig. 675). On the left side there remains only a fragment of the hyoplastron. The right and the left branches of the entoplastron are present, but the median and anterior part is missing. On the right side is seen the anterior portion of the epiplastron, while the posterior part of the left epiplastron lies close to the corresponding part of the entoplastron.

Judging from the fragments of these parts of the plastron that remain, the entoplastron and the epiplastra were not especially different from those of *Platypeltis ferox*.

The hyoplastron is not co-ossified with the hypoplastron. The suture is directed inward and forward, so that the anterior bone is narrower than the one behind it. The greater portion of these bones is covered with a large callosity. This is ornamented on the external ends of the bones with pits which resemble those of the carapace, but are not so large, there being about five in a line 10 mm. long. The inner ends of the bones are smooth, but display a cloth-like texture, produced by interwoven fibers of bone.

The xiphiplastra are missing; but the notches in the right hypoplastron show that these bones were articulated as in *Platypeltis*.

Three cervical vertebræ were exposed in preparing the plastron, the sixth, seventh, and eighth. All of these are turned backward, as if the head had been retracted within the shell. The sixth has a length of 75 mm. The structure of these vertebræ resembles that of *P. ferox*.

There is present also one ilium, but there appears to be nothing distinctive about it.

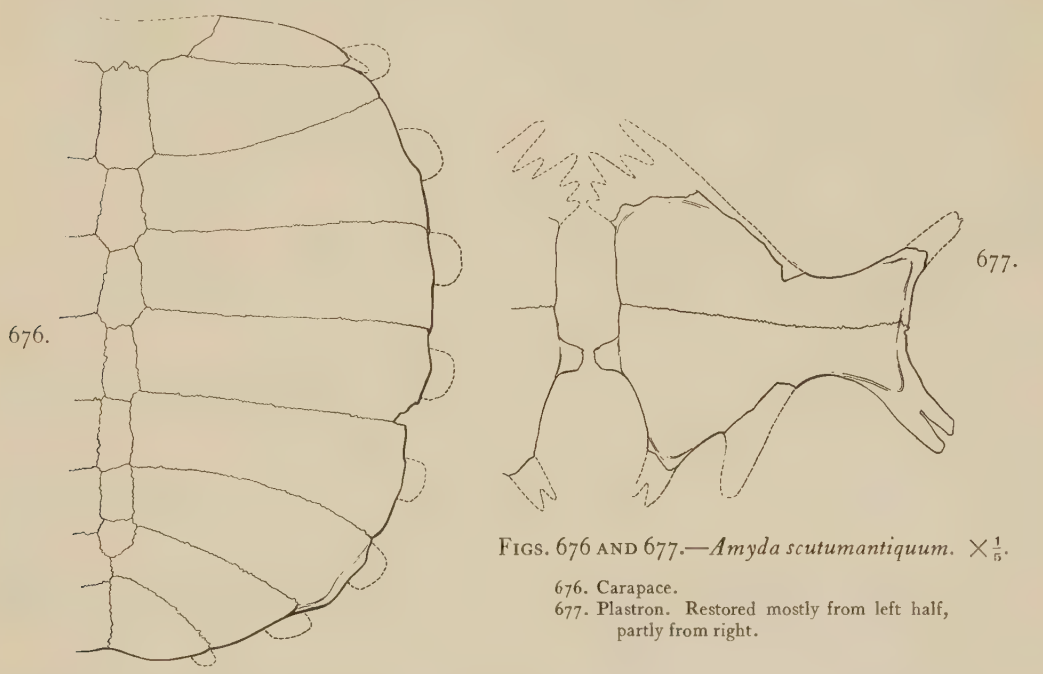
This species is very distinct from *Aspideretes guttatus*, but it might be very difficult to distinguish small fragments of the two. The last-named species has a much more elongated shell and a preneural, characters which readily distinguish it from *Amyda uintaënsis*. From *Amyda egregia*, which has similar ornamentation, it is distinguisht by the different form of the carapace and of the first neural; by the narrower neurals; and by the presence of 6, instead of 7, of them.

Amyda scutumantiquum Cope.

Plate 100, figs. 2–4; plate 101, fig. 1; text-figs. 676, 677.

Trionyx scutumantiquum, Cope, 6th Ann. Report U. S. Geol. Surv. Terrs., 1872 (1873), p. 617; Amer. Naturalist, xvi, 1882, p. 988, fig. 6; Vert. Tert. Form. West, 1884, pp. 118, 121, plate xvi, figs. 1, 1*a*.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.
Amyda scutumantiquum, Hay, Amer. Geologist, xxxv, 1905, p. 336.

The type of this species consists of a nearly complete carapace and a considerable part of the plastron, which were found in the Bridger beds, on Cottonwood Creek, in Wyoming. This specimen is now in the American Museum of Natural History and has the number 1035.



Figs. 676 and 677.—*Amyda scutumantiquum*. $\times\frac{1}{5}$.

676. Carapace.
677. Plastron. Restored mostly from left half, partly from right.

Professor Cope also referred to the same species, with some doubt, fragments which had been collected from the Wasatch deposits near Black Butte, Wyoming, and from the same formation on Bear River. Where these Wasatch specimens now are the present writer does not know.

On the page facing plate xvi of the Vertebrata of the Tertiary Formations of the West, Professor Cope states that his figures of this species are reduced to one-fourth the size of nature; but this is an error, the figures being almost exactly one-third the natural size.

This species attained a large size and possest a heavy shell. The length of the carapace (plate 101, fig. 1; text-fig. 676) of the type is 430 mm., measuring from the anterior portion of the nuchal. The width is very close to 400 mm. There was probably a broad but very

shallow sinus in the anterior border of the carapace. The rear is broadly rounded. The shell was considerably archt from the lateral borders to beyond the middle of the costal plates, the rise being about 82 mm. Along the middle of the back there is a rather deep depression.

The nuchal extended on each side of the midline at least 152 mm., and was 37 mm. wide fore and aft, perhaps somewhat more at the midline. There was no fontanel between it and the costals of the first pair and the first neural. Also there was no preneural. The first neural is large, being 68 mm. long and 37 mm. wide posteriorly. The others diminish in size to the seventh and last. The second and third are coffin-shaped, the next three nearly quadrilateral, and the last heart-shaped. This last one is only 22 mm. long and wide, and it separates only partly the seventh costals.

All the costals grow broader toward their outer ends, except the first and the last pairs. Those of the eighth pair are united in the midline by their entire width, and by their free borders they form 125 mm. of the hinder margin of the shell. At their free ends the most of the costals are beveled off to a sharp edge, except where the rib projects beyond the costal plate. Posteriorly the edge of the carapace is more obtuse. Near their outer ends the costals are about 9 mm. thick at the sutural border, and 12 mm. thru the rib. How far the ribs extended beyond the borders of the costal plates can not now be determined. Near the outer ends of the costals the ribs occupy nearly half the width of the lower surface of the plates.

The nuchal had a broad, smooth band along its front, and this band has continued around the greater part of the carapace, becoming very narrow behind. The sculpture (plate 100, figs. 3, 4) consists of the usual pits and ridges, the pits being rather deeply imprest and the ridges abrupt. There are 2 or 3 pits in 10 mm. They are large and distinct in the median depression (fig. 3) of the shell and on the middle of the length of the costals, smaller on the highest part of the carapace and on the outer ends (fig. 4) of the costals. As the smooth band is approacht, there is a tendency in the ridges to break up into tubercles. In figs. 3 and 4 of plate 100 the upper edge of the figure is that directed toward the head of the animal.

Besides the carapace, Cope figured the outer ends of the hyoplastral and hypoplastral bones of the right side; but the same bones of the left side, nearly complete, are present (fig. 677). The length of the suture joining them is 185 mm. The antero-posterior width of the hyoplastron at the inner end was about 90 mm.; that of the narrowest part, across the bridge, 35 mm. The antero-posterior extent of the inner border of the hypoplastron, exclusive of the processes, was 95 mm., that of the narrowest part, 28 mm.

The thickness of the plastron at the inner ends, between the ridges of bone which terminate in the digitations, is 9 mm. Thru the thickest part of the bridge the bone measures 15 mm.

The lower surface of the bone is ornamented, next to the outer end of the bridge, with sharp ridges running antero-posteriorly. At the inner ends of the bones the surface is covered with sharp tubercles. The remainder of this surface is merely roughened.

Amyda concentrica (Cope).

Plate 98, figs. 7–10.

Trionyx concentricus, Cope, Palæont. Bull. No. 1, 1872, p. 461; Proc. Amer. Philos. Soc., xii, 1873, p. 461; U. S. Geol. Surv. Terrs., 1872 (1873), p. 617; Vert. Tert. Form. West, 1884, pp. 118, 120, plate xvi, figs. 3–6.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.
Amyda concentricus, Hay, Amer. Geologist, xxxv, 1905, p. 336.

The type of this species consists of 4 fragments of costal plates, 3 of which belong to the proximal ends, and 1 to the distal end, of their respective plates. These were found in the Bridger deposits along Cottonwood Creek, Wyoming. In his earliest description Professor Cope states that the remains of this species are common in the Bridger beds; but the present writer knows of no specimens except the types. These are now in the American Museum of Natural History and have the catalog number 1049.

The animal to which the type costals belonged was a small one, probably about 160 mm. in length of carapace. The average width of the four costals is 19 mm. The thickness thru the sutural borders is 3 mm.; thru the ribs it is 4 mm. The sculpture appears to furnish characters for the identification of the species. On the proximal ends of the costals the pits

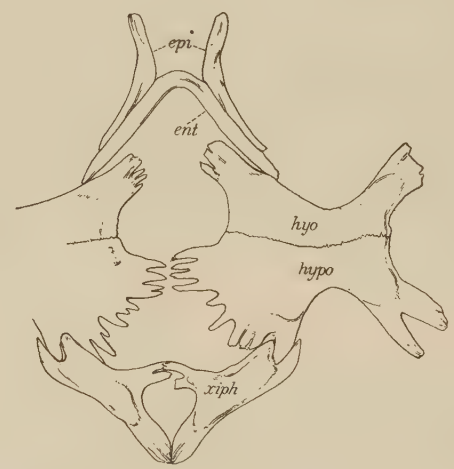
are usually large, there being 2 in a line 10 mm. long; but on the distal ends there may be 3 or 4 pits in this distance. These pits are arranged in somewhat irregular rows across the costal bones. Some of the ridges separating these rows are higher and have sharper summits than the others, these more conspicuous ridges running across the costals at a distance of about 10 mm. apart. There may thus be from 1 to 4 rows of pits between each two of these larger ridges.

Amyda franciscæ sp. nov.

Plates 102, 103; text-figs. 678, 679.

The fine specimen to which the name *Amyda franciscæ* is given was collected by Mr. Walter Granger, of the American Museum expedition of 1903, in the Bridger beds of Wyoming. The exact locality is the eastern part of the Grizzly Buttes; the level is that known as B. The specimen consists of the complete carapace and plastron; the seventh and eighth cervical vertebræ; both scapulæ and both coracoids; the pelvis, mostly hidden by the xiphiplastrals; the proximal ends of both humeri; most of the right hind leg; the left femur; and most of the left hind foot. The catalog number of the type is 5936.

678.



679.

FIGS. 678 AND 679.—*Amyda franciscæ*. $\times \frac{1}{5}$.

678. Carapace.
679. Plastron. *ent*, entoplastron; *epi*, epiplastron; *hyo*, hyoplastron; *hypo*, hypoplastron; *xiph*, xiphiplastron.

In form the carapace (plate 102; text-fig. 678) is broadly elliptical, slightly truncated in front and more decidedly truncated behind. Antero-posteriorly the carapace is slightly archt; more strongly from side to side. The length in a straight line is 315 mm.; the greatest width is 293 mm.

Neurals.	Length.	Greatest width.
1	55	35
2	44	29
3	40	29
4	34	24
5	31	19
6	28	17
7	27	17

This species is referred to the genus *Amyda* because of the presence of 8 pairs of costals and the absence of a preneural.

There are 7 neurals, of which the first is very large and the seventh much reduced. The anterior neural is considerably broader in front than behind. The table herewith presents the dimensions of the neurals. The four neurals succeeding the first are wider behind than in front; the next two are wider in front than behind.

The nuchal has a fore-and-aft extent of 36 mm., and is about 130 mm. from side to side. The anterior border of the bone is occupied by a narrow, smooth band. There appears to have been a small median fontanel between the nuchal and the first neural.

The form and the relative proportions of the costal plates may be seen from the illustrations. Their free borders are beveled off to an acute edge. The costal ribs are broad and they project

beyond the margin of the carapace about 30 mm. The thickness of the costals, measured at the sutures, is about 8 mm.; measured thru the ribs it is about 13 mm. The costals of the seventh and the eighth pairs meet their fellows along the midline. Those of the eighth pair are rather small.

The sculpture of the carapace is of median coarseness, there being about 3 pits in a line 10 mm. long. The pits are shallow and the rounded walls surrounding them are about as wide as the pits. For some distance on each side of the midline the sculpture is nearly obsolete.

The plastron (fig. 679) incloses large median fontanels. The entoplastron and the epiplastra are slender bones, resembling those of *Platypeltis spinifera.* They possess no "callosities." Nearly the whole surface of the hyoplastra and the hypoplastra is furnisht with pits and ridges, but these are not so coarse as those of the carapace, there being about five pits in a line 10 mm. long. These are better developt on the outer ends of the bones mentioned. The median borders of these bones show a band consisting of a network of bony fibers. The surfaces of the xiphiplastra present a similar interlacement of bony fibers.

The width of the bridge, where narrowest, is 51 mm., of which 26 mm. belong to the hypoplastron. The median border of this bone possesses about ten digitations, of which the two posterior are the largest and receive between them the inner process of the xiphiplastron. The xiphiplastra are slender bones. They join each other by means of anterior two-tootht processes and by broad posterior processes.

The bones belonging to the vertebral column, the shoulder and pelvic girdles, and the limbs present no peculiarities.

This species resembles in some respects *Amyda uintaënsis* Leidy. It differs, however, in being more elliptical in outline, in having the greatest width nearer the middle of the length, 7 neurals instead of 6, a differently formed first neural, a sculpture finer and of different character, and a narrower plastral bridge, of which the hypoplastron is wider than the hyoplastron.

Dedicated to the writer's daughter, Miss Frances Steele Hay.

Amyda salebrosa sp. nov.

Plate 104, fig. 1; text-fig. 680.

Amyda salebrosa is based on a specimen which was collected by Mr. Walter Granger at Dry Creek, in southwestern Wyoming, June 30, 1904. The level at which it was found is C, the middle of the Bridger deposits. Only the carapace is present, but this is practically complete. It bears the number 3941 of the American Museum's catalog.

The carapace (plate 104, fig. 1; text-fig. 680) was broad and probably rather flat. The front margin is broadly rounded, the rear truncated. The length is 425 mm.; the greatest width, 455 mm. Considering the great size of the carapace, it is rather thin, being only 8 mm. thick at the sutural borders, near the ends of the costals. Thru the ridges on the underside of the carapace, produced by the ribs, the thickness is 12 mm. The outer ends of the costals are beveled off from above.

The nuchal has a lateral extent of 267 mm., and a fore-and-aft extent of 57 mm. Its whole upper surface is pitted. Its outer ends overlap the outer anterior angles of the first costals.

Neural.	Length.	Width.
1	67	38
2	55	35
3	48	31
4	45	26
5	37	21
6	33	24
7	26	22

There are 7 neural plates, and these decrease in size from the first to the last. The accompanying table gives the dimensions.

The first neural is hexagonal, with the short sides consisting of the posterior and the two postero-lateral. The next two neurals have the narrow end directed forward; the fourth is nearly a parallelogram; the fifth and the sixth have the wider end in front; the seventh is pentagonal. The costals of the seventh pair join in the midline behind the seventh neural. Those of the eighth pair met along the midline for a distance of about 30 mm.; and each had a lateral extent of about 48 mm. The distal ends of the ribs project but little beyond the borders of the disk. In younger specimens they will doubtless be found to project a greater distance.

The sculpture of this species presents a rather peculiar appearance, being coarse, irregular and rough. The pits are irregular in size, form, in height of bounding walls, and in disposition with reference to each other. On the central portion of the disk, including the greater part thereof, there are from 2 to 5 pits in a line 20 mm. long. Around the borders of the carapace the pits are slightly smaller than elsewhere, but often not well defined. Everywhere the walls separating the pits are rather sharp and of varying height, often being lifted up into sharp points, especially in the angle formed by the junction of three pits.

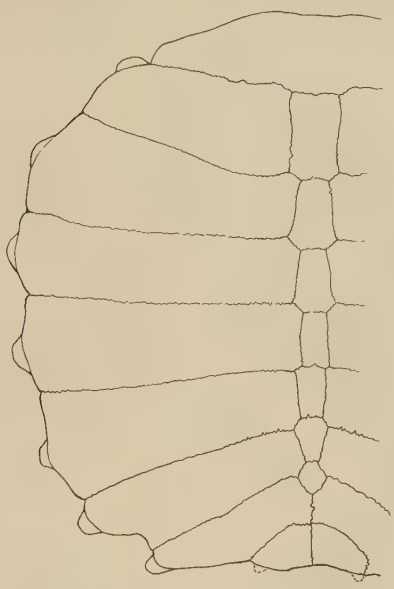


FIG. 680.—*Amyda salebrosa*. Carapace of type. $\times \frac{1}{6}$.

This species is sufficiently different from all others yet found. *Aspideretes guttatus*, *A. ellipticus*, and *A. grangeri* all have much more elongated carapaces. *Amyda egregia* has a thicker carapace, a smoother sculpture, and a nuchal less extended laterally. In *A. scutumantiquum* the carapace is more elongated, the nuchal is furnisht with a smooth band, and the sculpture is everywhere finer. In *A. radula* the nuchal is nearly straight in front.

It is *A. uintaënsis* to which the present species is most closely related. It differs from the latter in having the greatest width of the shell in front of the middle of the length; in having a more convex front; and in having larger and more irregular pits. The types of the two species are of almost exactly the same length and may therefore be more readily compared. *A. scutumantiquum* is longer than broad; *A. salebrosa* is broader than long.

Amyda? exquisita sp. nov.

Text-figs. 681–683.

This species is represented in the American Museum of Natural History by portions of 2 individuals, which were collected in the Bridger beds of the Grizzly Buttes, Wyoming, by the museum's expedition of 1903. Of these specimens, number 5923 is taken as the type. It consists of the carapace (fragmentary but representing well the structure), the hyoplastra and hypoplastra of both sides somewhat damaged, one cervical vertebra, portions of both humeri, the left femur, portions of the pelvis, and various other leg and foot bones. Of the other individual, No. 5943, there are present only the hyoplastron and the hypoplastron of the right side.

This species is markt among the species of the genus found in the Bridger beds by the thinness of the shell and the coarseness of the sculpture. The total length of the carapace (fig. 681) was very close to 375 mm.; the greatest width almost the same. Evidently the outline, both in front and behind, was slightly concave; laterally it is sinuous. The disk was filled out nearly to the ends of the ribs.

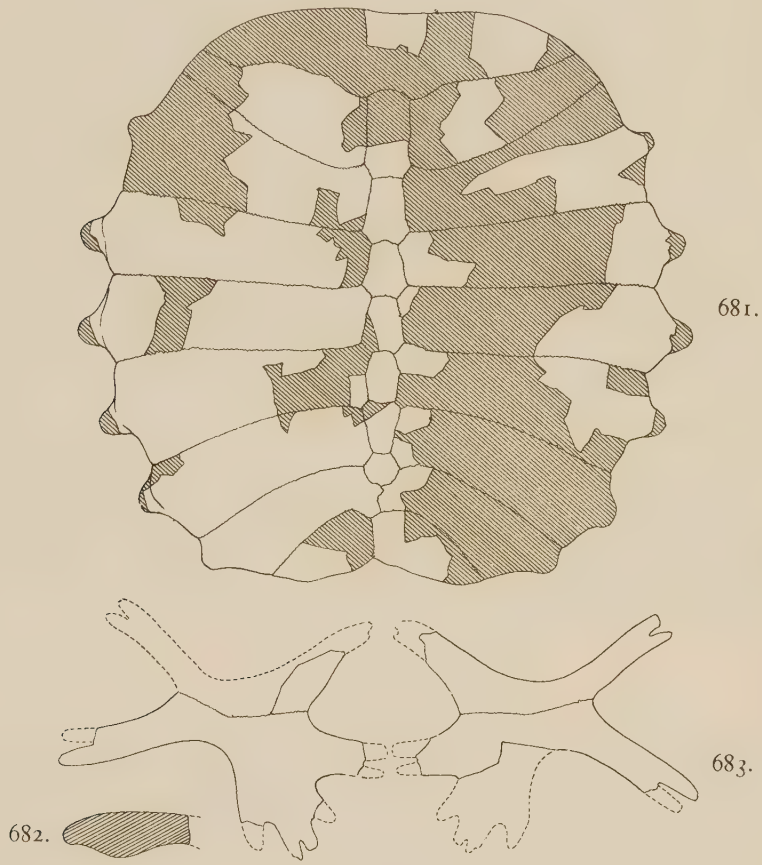
The thickness of the sutural border of the third costal plate, near the proximal end, is 6 mm.; but thinner toward the distal end of the plate. Thru the rib, in the middle of the width of the costal, the thickness amounts to 9 mm. The sutural border of the eighth costal is 7 mm. thick.

The exact dimensions of the nuchal bone can not be determined, there remaining only 2 fragments; but evidently the lateral extent of the bone was close to 250 mm., and the fore-and-aft extent, at the midline, very close to 50 mm. Fig. 682 represents a section of the bone along the midline. The free border is reduced to a subacute edge. Seen from above, the nuchal presents a smooth band along the anterior border. This is 13 mm. wide at the midline, but increases to twice this width toward the distal ends. The maximum thickness of the bone is about 13 mm.

From the materials at hand it can not be certainly determined whether there was a preneural bone; but probably this was absent. There are 7 neurals, the dimensions of which are

given in the table below. Of these neurals, the anterior was probably about as wide in front as behind. The next three have, as usual in the family, the narrower end directed forward. The fifth has the anterior end only slightly narrower than the hinder end. The sixth has the broader end in front. The seventh is heptagonal.

At the free border the costals are beveled off on the upper side.



FIGS. 681–683.—*Amyda? exquisita.* Type.

681. Carapace. $\times\frac{1}{5}$. Parts ruled with parallel lines are missing.
682. Antero-posterior median section of nuchal. $\times 1$. 683. Plastron. $\times\frac{1}{5}$.

On most portions of the carapace the sculpture, consisting of pits, is coarse. The bottoms of the pits slope up to the summits of the rounded walls. The average diameter is about 5 mm. On the hinder border of the nuchal the pits are smaller, about 5 in a line 20 mm. long. Those along the free border, too, have this size. On the proximal two-thirds or more of the costals there are usually 4 pits in a 20 mm. line. On the hinder third of the carapace they are still larger, 3 and sometimes only 2.5 in the line mentioned. Those on the anterior 4 or 5 neurals are very shallow.

Neural.	Length.	Width.
1	50	29
2	37	31
3	35	30
4	36	27
5	33	22
6	30	21
7	21	21

The plastron (fig. 683) is remarkable for the narrowness of the bridges and the depth of the notch between the outer process of the hyoplastron and that of the hypoplastron. The width of the bridge is only 47 mm.; in the paratype, No. 5943, an individual apparently as large as the type, the width is only 39 mm. The size of the fontanel inclosed between the outstanding processes of the plastral bones mentioned may be judged from the accompanying figure. There were also extensive fontanels along the midline.

The pits of the plastral bones are smaller than those of the carapace, about 7 in a 20 mm. line. Toward the mesial border of the bones the pits become obsolete and there comes into view a meshwork of bony fibers such as Cope found in his *Axestus byssinus* (*Axestemys byssina*). There is, however, no reason for thinking that the present species is identical with Cope's species just mentioned.

The cervical vertebra present appears to be the sixth. It has a length of 58 mm. An estimate shows that the length of the neck was about 380 mm. The bone appears to be slenderer than the corresponding bone of a specimen of *Platypeltis spinifera*.

The fragmentary bones belonging to the shoulder and pelvic girdles and to the limbs furnish few noteworthy data. The total length of the humerus is 125 mm. The shaft is slenderer than that of *Axestemys byssina;* the least diameter of the former being 8 mm., that of the latter 17 mm., while the length of the humerus of *Axestemys* appears not to have been much greater than that of the present species.

This species is at once distinguisht from *A. salebrosa* by the greater development of the costals of the two hinder pairs and by the greater width of most of the neurals. The greater breadth of the carapace, the greater length of the nuchal from side to side, and the longer eighth costals distinguish it from *A. egregia*. Comparison with *A. concentrica* is required.

Amyda mira sp. nov.

Plate 105, fig. 1; plate 106; text-figs. 684–686.

Under the above name is described a trionychid which was discovered by the American Museum party of 1905, at Grizzly Buttes, Wyoming, in level B, of the Bridger Eocene. The specimen bears the number 6130. It furnishes the skull, without the lower jaw; the carapace complete; and the plastron, excepting the entoplastron, the epiplastra, and a portion of the left hyoplastron.

The carapace includes 8 pairs of costal plates and there is no preneural; hence the genus *Amyda* is indicated. The carapace (plate 105, fig. 1) is about as wide as long, broadly rounded behind, more sharply rounded in front, and of considerable convexity. The length in a straight line is 263 mm.; the extreme width is 252 mm.; the height of the center is 62 mm. above the borders. On the sides the free borders of the costals are beveled off; in front, the nuchal and the first costal are trimmed off at right angles with the upper surfaces.

Neural.	Length.	Width.
1	44	24
2	31	23
3	30	22
4	27	20
5	24	18
6	20	14
7	17	18

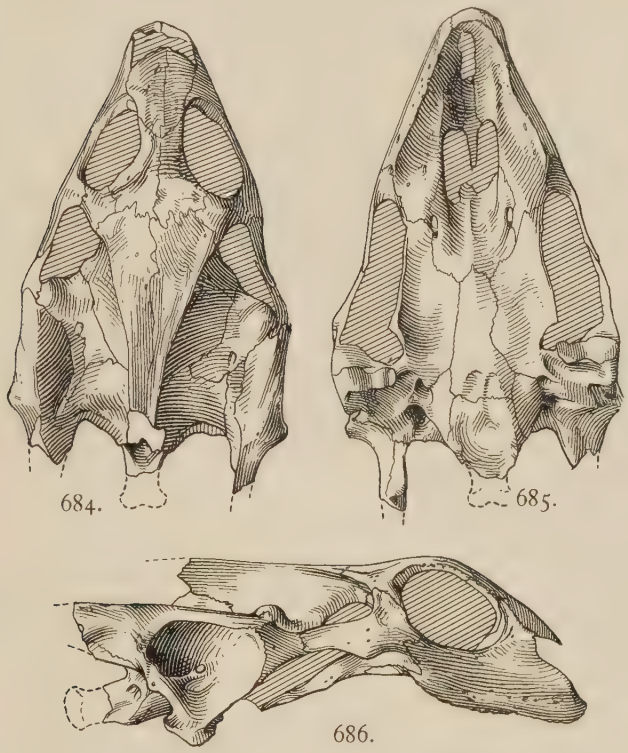
The nuchal is 27 mm. wide, 134 mm. from extremity to extremity, and 97 mm. from its union on the free border with the second costal to the same point on the other side. The extremities of this bone are contained each between two plates of the second costal.

There are 7 neurals, all except the first, the sixth, and the seventh being hexagonal, with the broad end behind. The dimensions are given in the table.

Of the costals the sixth and the seventh meet their fellows at the midline. Those of the seventh pair are well developt. They join along the midline a distance of 30 mm. and each has a width along the free border of about 33 mm. The extremities of the various costals have a thickness of 5 mm. at the sutural edges and of about 8 mm. thru the rib. The ribs are markt off distinctly the full length of each costal plate. Those along the sides of the carapace project about 20 mm. beyond the border of the disk, but that of the eighth costal projected about 40 mm.

The surface of the carapace is ornamented with pits and grooves and intervening ridges. On the rear are 10 or 12 distinct longitudinal welts. The ridges are narrow, sometimes sharp. The pits frequently coalesce, especially on the distal ends of the costals, to form grooves. These show a tendency to run parallel with the axis of the animal. On the neurals the pits are smaller than on the costals, about 6 of them in a line 15 mm. long. On the proximal ends of the costals there may be as few as 3 pits in the given line. On the distal ends of the costals there are usually about 5 pits or grooves in the line mentioned.

The plastron (plate 106, fig. 1) has a breadth, from the extremity of the hyoplastral processes of one side to those of the other, of about 310 mm. The outer fourth of the hyoplastron of each side has coalesct with the corresponding hypoplastron. The transverse extent of these bones, along this suture, is 133 mm. Where narrowest the bridges are 48 mm. wide. The hyoplastron and hypoplastron have a close resemblance to those of *Platypeltis ferox*. The hypoplastron differs from that of the species just named in having a greater number of digitations directed toward the midline.



FIGS. 684–686.—*Amyda mira*. Skull of type. ×0.9.

684. Seen from above. 685. Lower aspect. 686. Right side.

The xiphiplastrals are concave along the outer border, whereas those of *P. ferox* are convex. In the latter species there is a single process which meets the single process from its fellow bone; in *A. mira* there is on the left side a broad process which is received between two slenderer processes of the right side.

Nearly the whole inferior surface of the hyoplastra, hypoplastra, and the xiphiplastra is covered with a sculptured layer of bone, the callosities, as they are called in living trionychid turtles. The pits and ridges are less strongly developt than on the carapace. They are most distinct on the outer ends of the hyoplastra and hypoplastra. Here there are about 5 pits in a 10 mm. line. On the mesial halves of these bones the pits are very shallow. The sculpture on the xiphiplastra is feebly exprest.

The skull (fig. 684–686) is beautifully preserved. It lacks the lower jaw, the occipital condyle, the supraoccipital process and parts of the squamosal processes.

The approximate length of the skull, from the tip of the snout to the occipital condyle, is 72 mm.; the greatest width, at the upper posterior border of the tympanic cavity, is 45 mm. From the fronts of these cavities the sides of the skull converge to near the narrow and rounded snout. The flexure of the skull behind the choanæ is remarkable, fully as great as in *A. cartilaginea*, while the descent of the face is still more rapid than in the living species just named.

The sutures between the bones are yet open, but no remarkable relations have thereby been shown. The tympanic chambers are large, each diameter being 16 mm. The zygomatic fossæ are small, only 14 mm. long. The orbits are unusually large, the horizontal diameter being 16 mm. equal to that of specimen of *Platypeltis ferox* whose skull is 94 mm. long. The vertical diameter is 13 mm. The interorbital space is only 4 mm. wide. Each diameter of the nares is 10 mm. The snout projects 20 mm. in front of the orbits.

The pterygoid portion of the palate has a width of 25 mm. The anterior portion of the skull is remarkable for the depth of the groove in which the choanæ are situated. This begins at the posterior palatine foramina and extends forward to the premaxillæ. It has a depth of 5 mm. and a width of 8 mm. The choanæ are placed well backward, the middle of the length of each being opposite the middle of the orbits. Each is 10 mm. long. The triturating surfaces of the upper jaws are 6 mm. wide opposite the choanæ, but they narrow gradually forward.

Altho the lower jaw is missing one of the ceratohyals is preserved. Most of the internal skeleton is preserved, but it has not been cleared from the matrix.

This species resembles in some respects *A. franciscæ*. However, the carapace of the latter is somewhat excavated at the midline in front, the rear is more truncated, and the ridges of the sculpture have broad and rounded summits. The anterior border of the hyoplastron is very concave; that of *A. mira* is gently sigmoid. Likewise, the mesial border of the hypoplastron of *A. franciscæ* has a greater number of digitations.

There are points of resemblance between *A. mira* and *Platypeltis heteroglypta*. In the latter, as in others of the genus, the eighth costals are wanting or only feebly developt. The form of *P. heteroglypta* is different from that of *A. mira*, the front of the carapace is more rounded and the rear more truncated. The nuchal is relatively longer and there is an unsculptured band along its front. It is observed, too, that the ribs on the underside of the costals are broader in *P. heteroglypta* than in the subject of the present description. The width of those of the second, third, and fourth costals of *P. heteroglypta*, taken near the distal end, is 24 mm. each. In *A. mira*, the rib of the second is 22 mm. wide; the third, 20 mm.; the fourth, 18 mm. *P. heteroglypta* was probably a flatter species, but the specimens are much crusht.

Amyda? tritor Hay.

Text-figs. 687–689.

Aspidonectes tritor, HAY, Science (2), XIX, 1904, p. 254.
Amyda? tritor, HAY, Amer. Geologist, XXXV, 1905, p. 336.

This species is based on a large and well-preserved skull which was collected by the writer in the Bridger deposits, about 3 miles above the mouth of Cottonwood Creek, east of Fort Bridger, Wyoming. The matrix in which the specimen was found is a calcareous and argillaceous sandstone belonging to the base of the middle third of the Bridger beds. The number of the skull, in the American Museum catalog, is 5913.

The total length of the skull (figs. 687–689) is 162 mm.; and it has therefore belonged to a large animal. In the American Museum of Natural History there is a specimen of *Platypeltis ferox*, the carapace of which has a length of 265 mm. and whose skull has a length of 116 mm. If the skull and carapace of *A. tritor* had the same ratio that obtains in these parts in *P. ferox*, the carapace of the former would have had a length of about 370 mm. This is somewhat less than the length of the carapace of Leidy's *Trionyx uintaënsis*, and considerably less than that of the carapace of Cope's *T. scutumantiquum*. The skull under consideration may therefore have belonged to one or the other of these or to some other described species. For the present it is necessary to give a distinct name to this skull and await further discoveries.

The following are the principal measurements of the skull:

	Millimeters.
Length from snout to end of supraoccipital spine	162
Length from snout to end of occipital condyle	123
Width from outside to outside of quadrates	91
Width across pterygoids	47
Width of interorbital space	20

In general form the skull resembles that of *Platypeltis ferox;* but the width is somewhat greater, the snout is shorter and less pointed, the interorbital space is broader, and the choanæ are more constricted. The facial angle is about the same in the fossil as in the living species, the roof of the mouth being bent down about 25° below the plane of the pterygoids. The sutures between the various bones are more finely dentated than in *P. ferox*. The skull appears not to have suffered distortion during fossilization.

The snout is broad and blunt. The narial opening is 22 mm. wide and only 12 mm. high. The co-ossified premaxillæ are small, measuring from side to side only 9 mm. The external surface of the maxilla is perpendicular, and the outline, seen from above, is slightly concave. Seen in profile, the skull is nearly flat behind the orbits, whilst more anteriorly there is a gradual curve to the end of the snout. In *P. ferox* there is an abrupt change of direction between the hinder borders of the orbits.

The paroccipitals have about the same relative size and disposition as in *P. ferox*. The portion of the quadrate exposed between the prootic and the squamosal appears to be somewhat narrower than in the living species mentioned.

On the lower surface of the skull (fig. 688) are to be noted the broad triturating surfaces of the maxillæ, each presenting about the same relative amount of surface as in *P. ferox*. The transition between the triturating surface and the cutting-border of the jaw is rather abrupt. The choanal fossa is likewise formed somewhat abruptly. In the midline in front of the choanæ may be seen the suture where the inner borders of the maxillæ meet below the vomer. A portion of the vomer is exposed in front of this suture. The anterior palatine foramen is small, only 7 mm. long, while in the specimen of *P. ferox* referred to above, it is 11 mm. long.

FIGS. 687–689.—*Amyda? tritor*. Skull of type. $\times \frac{2}{3}$.

687. View of upper surface. 688. View of lower surface. 689. View of right side.

The choanæ are relatively small, being constricted as in *Amyda cartilaginea* and *A. sinensis*, and the constriction has been produced in the same manner in the fossil, as in living species.

The basioccipital bone is rather broad, occupying nearly one-third of the width of the posterior part of the roof of the mouth, the lateral portions being formed by the pterygoids. This region is slightly concave both transversely and longitudinally. The articular surface of the quadrate is 20 mm. wide, from side to side, being relatively greater than in the case of *P. ferox*. The squamosal processes, formed by the backward extension of the squamosal and the paroccipital bones, are large and scroll-like.

Seen from the side the cutting-edge of the maxilla is convex from front to the hinder end. The zygomatic arch has only moderate width. The tympanic cavity did not extend so far backward into the squamosal as it does in *P. ferox* and *P. spinifera*.

Until we shall have secured the carapace of this species in association with the skull, we must remain uncertain as to the genus to which it belongs.

Amyda egregia sp. nov.

Plate 107, figs. 1–3; text-fig. 691.

The type of this species is a complete carapace which was collected in 1895, by Mr. O. A. Peterson, in charge of the American Museum expedition of that year. It was obtained from the lower Washakie beds, south of Haystack Mountain, Wyoming. The number is 1186.

Neural.	Length.	Width.
1	56	37
2	44	31
3	38	31
4	38	26
5	34	22
6	30	19
7	21	25

The shell (plate 107, fig. 1; text-fig. 691) is broad, rounded in front, truncate behind, and moderately convex. The border is slightly emarginate on each side at the suture between the nuchal and the first costal plate; elsewhere gently repand. The length of the carapace, in a straight line, is 356 mm.; the greatest width is 334 mm.

Of neural plates there are seven present. The table gives their dimensions. The first neural is only 25 mm. wide at its hinder end.

The nuchal has a transverse extent of 150 mm. and measures fore and aft 22 mm. Its outer extremity overlaps the free end of the rib of the first costal plate.

The shell of this species is quite thick and solid. The thickness of the fifth costal plate, a little beyond the middle of the length and at the sutural edge, is about 10 mm.; in the middle of the width, where the rib lies, the thickness equals 15 mm.

The ribs do not appear to have projected much beyond the margin of the carapace, apparently only about 30 mm. At the margin the shell is beveled off rather abruptly, but the sculptured layer nowhere projects beyond the deeper layers of bone. On the front of the nuchal the bevel of the margin becomes a broad shallow groove.

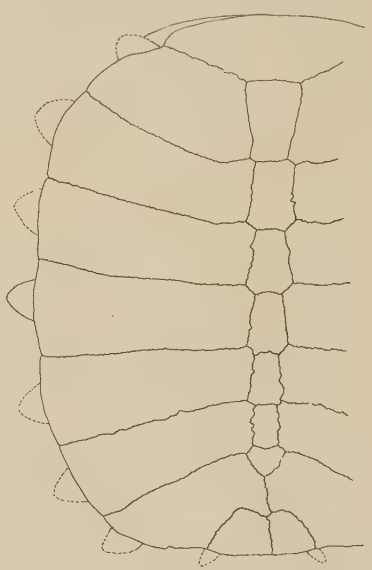


Fig. 691.—*Amyda egregia*. Carapace of type. × ⅛.

The sculpture of this species is very coarse. In the central portions of the carapace (plate 107, fig. 2) it consists of rather shallow pits separated by broad low ridges, the whole forming a honeycomb structure. The ridges are nearly as broad as the pits. About three pits, occasionally four, occupy a line 20 mm. long. The pitting is coarsest on the hindermost costals, and here too the ridges become more elevated. On the outer fourth of the costals (plate 107, fig. 3) the ridges and pits are arranged in rows across the costals, the connecting ridges being less conspicuous than those crossing the plates. Near the margin the irregular honeycomb arrangement is again found. Where the pits are in rows they are large and the ridges conspicuous.

This species somewhat resembles in its sculpture *Aspideretes guttatus;* but in the latter species the ridges separating the pits are in nearly all cases narrower and sharper. The sculpture is likewise not so coarse on corresponding parts of the shell. The two species are greatly different in other characters.

Amyda uintaënsis (Leidy) likewise presents a similar coarse sculpture, but the ridges intervening between the pits are narrow and sharp. Other characters clearly distinguish the two species. The nuchal of *A. uintaënsis* has a considerably greater transverse extension than in *A. egregia*. The anterior border of the shell formed by the nuchal is more truncated. The neural plates differ in form and proportion, and there are only 6 of them. There are differences in the last costals.

Amyda crassa sp. nov.

Plate 108; text-fig. 692.

This species is founded on a fragmentary carapace, No. 3887 of the American Museum of Natural History. This was collected by that museum's expedition of 1895, in the upper beds, "horizon C," of the Uinta deposits, in the region along White River, Utah. The parts present include a considerable portion of the costals, a few of the neurals, and nearly the whole of the nuchal. Most of the left second costal is missing, about the distal half of the right third, portions of both costals of the fourth pair, and practically all of those behind the third of the right side. There is also at hand a portion of a plastral bone of another individual, probably of the same species; and this is labeled "top of B, Uinta."

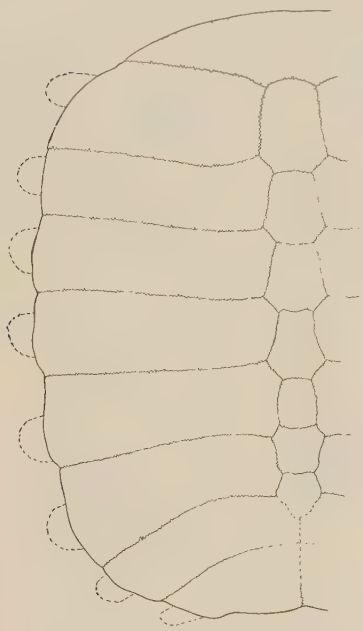


Fig. 692.—*Amyda crassa.* Carapace of type. $\times\frac{1}{6}$.

In form the carapace (plate 108; text-fig. 692) is broadly oval, with the length exceeding the breadth, and with the greatest width at the middle of the length. The length is 475 mm.; the extreme width, 420 mm. The anterior border is regularly rounded, while the hinder border is rather truncated. The carapace was apparently only moderately convex. There were 8 pairs of costal plates and 7 neurals.

This species is remarkable for the thickness of the bones of the carapace, and for the coarseness of the sculpture, equaling and even surpassing in these respects any of the species of the Wasatch deposits. The usual thickness of the costals is, near the sutural borders, 10 mm.; thru the middle of the width, 13 mm. The thickness of the outer end of the nuchal is 18 mm. The sculpture consists of ridges and pits, usually very irregular in form and size and arrangement. The largest pits may be 8 mm. across; but there are commonly 2 in about 10 mm. The ridges separating them may be as broad as the pits, but more often they are narrower and rather sharp. Their elevation likewise varies greatly. On the proximal ends of the costals there is little or no regularity in their disposition, but toward the distal ends the pits and ridges are arranged in rows running across the costals.

The nuchal bone of this species resembles that of *A. uintaënsis* (Leidy), described and figured in this author's Contributions to the Extinct Vertebrata of the Western Territories, p. 178, plate xxix, fig. 1. Its length from side to side is not far from 275 mm., while its fore-and-aft extent is 58 mm. It is pointed at the outer ends. There were no fontanels between it and the first neural and the first pair of costals. There is a shallow groove, about 10 mm. wide, running along near the anterior border; and this border is beveled so that the upper surface somewhat overhangs the lower.

The free borders of the two anterior costals and of the more posterior ones are rounded off, but the intermediate ones are beveled. The first costal is very broad, about 77 mm. across the middle. The succeeding ones up to and including the fifth are considerably narrower, about 52 mm. The sixth is 47 mm. wide at the proximal end, while its distal end is about 80 mm. The width of the seventh at the proximal end appears to have been about 36 mm., while the outer end, measured along the oblique free border, is 60 mm.

Only a few neurals are present, and none of these is complete. Nearly the whole of the first is present. It is coffin-shaped, and the front end is convex. The length was close to 70 mm.; the width of the anterior end, 36 mm.; that of the widest part, near the hinder end, 52 mm. Of the forms and dimensions of the second, third, and fourth neurals, we can judge only from the spaces which intervene between their contiguous costals when these are in place. They were all smaller than the first, but of the same general form. The second, about whose dimensions we can be most certain, had a length of 57 mm., and a width at the hinder and wider end of 43 mm. The fifth neural is present only in part. Its length appears to have been

44 mm. and its width close to 30 mm. It was probably only a little narrower at the anterior end. It articulated with only the fifth costal. Most of the sixth neural is present. It was parallelogrammic, 40 mm. long and 32 mm. wide. It articulated with the hinder proximal angle of the fifth costal, and the greater part of the proximal end of the sixth costal. The seventh neural is partly present, and was probably about 25 mm. long and 34 mm. wide. It articulated with the sixth and seventh costals on each side. It is not probable that there was an eighth neural. Consequently, the seventh costals joined in the midline, as did also the eighth costals.

The portion of the plastral bone already referred to is identified as the outer end of the right hypoplastron. Its catalog number is 3886. It includes the two digitations at the external angle and the remainder of the bone inward somewhat beyond the narrowest part of the bridge. The width, where narrowest, is 32 mm. The length of the longest digitation is 65 mm. The thickness at the free border equals 12 mm.; that thru the narrowest part of the bone, 23 mm. The distal free border is beveled off. The lower surface of the bone is furnisht with a sculpture consisting of coarse pits and ridges, arranged, where well preserved, in rows parallel with the outer border.

Amyda crassa appears to resemble somewhat *A. uintaënsis* (Leidy), but it differs in various ways. The latter species has its greatest breadth somewhat behind the middle of the length. The nuchal bone of *A. crassa* is longer, from side to side, in proportion to its width. The neurals of Leidy's species are narrower and with more nearly parallel sides. Moreover, there were only 6 neurals, whereas, in *A. crassa*, there are 7.

Two costal bones, No. 1021 of the American Museum, found in 1895, near the top of division B of the Uinta beds, belong apparently to this species. They indicate a greater convexity of the carapace than is shown by the type.

Amyda? lima Cope.

Plate 98, fig. 11.

Trionyx lima, Cope, Proc. Acad. Nat. Sci. Phila. 1869, p. 12; Amer. Naturalist, III, 1869, p. 90; Trans. Amer. Philos. Soc., XIV, 1869, pp. 151, 153, plate vii, fig. 14; Proc. Amer. Philos. Soc., XIV, 1875, p. 363.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.

The original description of this species is exceedingly brief, and was not accompanied by a figure. A sufficient description and figure were, however, publisht in the same year. The type and only known specimen, now in the American Museum of Natural History, is a fragment of the distal end of one costal. It is remarkable for its heavy construction. The bone was somewhat decayed and eroded; and it is not certain that we have present either of the sutural borders. It is probable, however, that we have nearly the original width of the bone. The present width is 47 mm. The thickness, which includes the rib, is 18 mm. Even near the supposed sutural border the thickness is 14 mm. The rib probably projected somewhat, but how much can not be determined. At the free border the bone is cut off at nearly right angles with the upper surface. The under surface stands out somewhat farther than the upper, so that there is a shallow groove occupying the free border.

As Cope suggests, the most conspicuous character of this species is found in its sculpture. This consists of rather high and narrow ridges which run across the bone, and separate grooves which are somewhat wider than the ridges themselves. The summits of the ridges are uneven and are sometimes cut quite to the bottom. There are remarkably few connecting ridges; but occasionally a ridge is found to divide; or it may suddenly come to an end. The distance across two grooves is about 7 mm. On the proximal end of the fragment the ridges are somewhat irregular in their course; at the distal end they are narrow and much interrupted.

In the American Naturalist, Professor Cope remarks concerning this species:

> The Trionyx of our Miocene (*T. lima* Cope) was large and rough, with narrow ridges. Its remains occur with dolphins and porpoises, but it may have been floated or washed from the mouth of a freshwater stream into such strange company.

There are, however, reasons for believing that some species of the Trionychidæ are not averse to living in salt water.

This species was found in the Miocene marl, in Cumberland County, New Jersey.

With so little of the skeleton of this species for examination, it is impossible to determine with any degree of certainty the genus to which it belongs.

Amyda? buiei (Cope).

Plate 98, fig. 12.

Trionyx buiei, Cope, Trans. Amer. Philos. Soc., xiv, 1869, pp. 151, 153; Kerr's Report Geol. N. Carolina, 1, Append. B, 1875, p. 34.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 453.

In the original description of this species Professor Cope stated that it was represented by numerous costal bones in a more or less fragmentary condition. Of these fragments only a single one has been recognized in the Cope Collection in the American Museum of Natural History. A figure of this is presented on plate 98. The fragment belongs to the distal end of a costal plate, and extends from one sutural margin to about the middle of the width of the plate. The thickness is slightly less than 5 mm. at the sutural border, and about 6 mm. thru the rib. The distal end of this plate was probably about 30 mm. wide.

The sculpture consists of rather low and narrow ridges, which run in a curved course across the bone. Some distance from the sutural border the ridges begin to be connected by cross-ridges, so that the intervening furrows become broken up into pits of irregular sizes. Two of the furrows occupy a space of about 5 mm. The furrows and pits are considerably broader than the ridges themselves. It is not unlikely that the proximal ends of the costals will have the pitting extended to the sutural borders.

The little matrix which yet adheres to this bone is very green.

From the Miocene near Mount Olive, Duplin County, North Carolina.

Until additional materials belonging to this species are forthcoming we must remain uncertain as to its generic relationships.

Amyda? cellulosa (Cope).

Trionyx cellulosus, Cope, Proc. Acad. Nat. Sci. Phila. 1867, p. 142.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 453.—Case, Maryland Geol. Surv., Miocene, 1904, p. 62.

The unsatisfactory remains on which the present species was founded were collected, as stated by Cope in the beginning of the paper cited above, in Charles County, Maryland, not far from the Patuxent River, in the beds of the Yorktown epoch. These remains were never figured and appear to be lost. The following is Cope's original and only description of them:

> Two small fragments of the carapace are all that represent this species. The sculpture is, however, exceedingly characteristic, and different from that of any recent or fossil species known to the writer.
>
> The surface is marked by numerous closely placed pits, which are remarkably deep, producing the vesicular appearance of scoria. The resemblance is heightened by the irregular size of the pits. Edges of septa rounded. The fragments are unusually thick, indicating a species of large size.
>
> | | Lines. | |
> |---|---|---|
> | Width of free portion of rib at origin | 7.5 | [15.6 mm.] |
> | Depth of portion of carapace | 4.33 | [9 mm.] |

The deposits in which this species was found are now known as the Calvert formation of the Miocene.

In the same locality and formation Professor Cope found other fragments of a trionychid which exhibited larger and more regular pits, separated by wider partitions (Proc. Phila. Acad. 1867, p. 143). To these he gave no specific name and the specimens appear to be lost.

Genus TEMNOTRIONYX nov.

Triturating surface of maxilla with a sharp ridge running parallel with the cutting-edge of the jaw. Presence of preneural and the number of the costals unknown.

Type: *Temnotrionyx manducans* Hay.

Temnotrionyx manducans sp. nov.

Plate 105, figs. 2, 3; text-fig. 690.

In the Bridger beds, near the mouth of Cottonwood Creek, Wyoming, in 1903, the writer found some fragmentary remains of a trionychid which appears to be hitherto undescribed. The specimen is now in the American Museum of Natural History, New York, and has the catalog number 5929. The remains consist of the left quadrate and prootic, a portion of the right maxilla, the median portion of the nuchal, one neural, probably the fifth or sixth, the

sixth costal plate nearly complete, fragments of several other costals, nearly the whole of the right hyoplastron, the mesial two-thirds of the right hypoplastron, one cervical vertebra, the proximal portion of the right femur, the distal end of the right humerus, and some other, but unimportant, fragments. Whether or not there was a preneural can not yet be determined.

The individual was a very large one, the plastral bones indicating that the width of the plastron was little short of 600 mm. An estimate, not wholly reliable, made from the costals present, indicates that the length of the carapace was about 500 mm. It is quite probable that the carapace was at least as broad as long.

The skull was correspondingly long. A comparison of the united quadrate and prootic with those of *Platypeltis ferox* indicates a length of skull of 225 mm. from snout to occipital condyle, but little less than nine inches. The fragment of maxilla indicates a shorter skull, about 7 inches. It is not improbable that the front of the skull was relatively short. The quadrate and prootic offer no peculiarities when compared with those of *Platypeltis ferox*, except that in the latter the anterior ends of the borders which articulate with the parietal and the quadrate respectively rise considerably as they approach these bones, thus making the anterior end of the prootic somewhat gutter-like; whereas, in *T. manducans* the rise of the prootic on each side is slight and the front border of the bone is quite flat.

The fragment of the maxillary offers the most interesting modification. Fig. 2 of plate 105 represents the bone from the outside; fig. 3 from below. The lower border of the bone forms a prominent cutting-edge, such as we find in many other trionychids. Inside of this cutting-edge there is, in other trionychids, a horizontal masticatory surface which may be very narrow

FIG. 690.—*Temnotrionyx manducans*. Plastron of type. $\times \frac{1}{6}$.

or of moderate width, or very broad; but it is always nearly plane. In *T. manducans*, on the contrary, this masticatory surface is traverst from one end to the other by a sharp ridge, such as we find in various Emydidæ and Testudinidæ. The ridge is not at all toothed. Mesiad of it the palatal surface of the bone past inward and somewhat upward to the choanæ, and to meet the vomer in front and the palatine behind. The structure of the jaw indicates that the animal was accustomed neither to seizing and swallowing whole a living prey nor to crushing shells and other hard objects; but rather to masticating animal and vegetable substances of a moderate hardness.

The nuchal bone offers one peculiarity. In the midline, on the under side equally removed from the anterior and the posterior borders, is an oval depression 14 mm. long and 10 mm. wide. It probably served as the attachment of a ligament. The bone does not come to an edge in front, but is truncated. The thickness is 16 mm. The antero-posterior extent of the bone was 55 mm. The lateral extent is unknown. There appears to have been a smooth band along the anterior border, narrow at the midline, while the remainder is covered with shallow pits, 4 or 5 in a 20 mm. line.

Some of the costals indicate a considerable convexity of the carapace. One fragment from the middle of the length of the shell has a width of 65 mm. and a thickness of 10 mm., near the sutural border. The sixth costal is 51 mm. wide proximally and 95 mm. wide at the free border. Its thickness is 12 mm. at the posterior sutural border. The upper layer of the bone of the costals overhung somewhat the middle layer, so that there was a sharp channel running around the border of the carapace. Notwithstanding the age of the individual the ribs projected considerably beyond the borders of the disk, in one case 42 mm.

The sculpture of the carapace was of moderate coarseness. On the distal halves of the costals the pits are in rows parallel with the free border of the costal, and there are five of these rows in a line 20 mm. long. Proximally the pits are no longer in rows and are larger, 3 or 4 in the distance named. The sutural borders of the costals are striated across the sutures.

Fig. 690 represents the known bones of the plastron. A portion of the hyoplastron is missing, but it is quite certain that the outer end has been placed very close to its proper position. This bone had an extent laterally of about 252 mm., not including the antero-external spine. It is remarkable for the narrowness of the end next the midline, this being only 60 mm. The width at the bridge was about 52 mm. The greatest thickness of the bone is about 17 mm. The outer end of the hypoplastron is wanting, as well as the hinder border of the bone. The bottom of the notch receiving the inner process of the xiphiplastron is present, so that the form of the hypoplastron given in the drawing is not far from correct. The width at the narrowest part of the bridge is 37 mm., being thus less than that of the hyoplastron. The thickness at the bridge is 21 mm.

On account of the advanct age of the individual, the layer of the bone forming the "callosities" extended itself to the ends of the processes at the midline. The lower surface of the plastral bones is nearly smooth, but shows everywhere the vestiges of pits and ridges. Where distinct enough to be perceived they seem to have been smaller than those of the carapace.

The sculpture of the carapace of this species resembles that of *Amyda uintaënsis*, consisting of large pits at the proximal end of each costal and somewhat smaller ones in rows at the distal end. Those of *T. manducans* are, however, somewhat larger, in corresponding situations. The shell, too, is thicker. The greatest differences are found in the plastra of the two species. In *A. uintaënsis* the inner end of the hyoplastron is two and a half times as wide as the narrowest portion at the bridge; whereas, in *T. manducans* the two portions are of nearly the same width. The front border of *A. uintaënsis* was quite concave, while that of *T. manducans* was nearly straight. It is not probable that such differences can be due to difference in age. The type of *A. uintaënsis* is about four-fifths as large as that of the present species.

From *Amyda scutumantiquum* the present species differs in the same way that it does from *A. uintaënsis;* that is, in the narrowness of the inner end of the hyoplastron. *A. radula*, whose nuchal has a similar thickened anterior border, differs in having a thinner shell, the free borders of which are beveled, and in having a finer sculpture. *A. egregia* has a thicker shell, a coarser sculpture, and no overhanging layer at the free borders. *A.? cariosa*, of the Wasatch of New Mexico, evidently had much deeper and more abrupt pits on the proximal ends of the costals. The bone regarded by Cope as a xiphiplastral was deeply pitted, a condition not to be expected in *T. manducans*. *Aspideretes guttatus* has a different sculpture and a relatively broader bridge. *Aspideretes ellipticus* had a nuchal whose anterior border was beveled off on the upper surface.

Genus PLATYPELTIS Fitzinger.

Carapace with the eighth pair of costals wanting or greatly reduced. No preneural. One or two of the posterior pairs of costals may be in contact on the midline, or all may be separated. Young in the living species with smooth or granulate skin.

The type of the genus *Platypeltis* is *Testudo ferox* Schneider (=*Trionyx ferox* of Boulenger's Catalogue). The known living species are all inhabitants of North America.

Key to Fossil Species of Platypeltis.

A^1. Puerco or Torrejon species:
1. Nuchal probably loosely attacht to first costals. No welts on carapace. Six pits in a line 10 mm. long ..... *antiqua*

A^2. Wasatch species:
1. Disk of carapace not as wide as long; with ribs projecting far beyond disk. Nuchal probably loosely connected with its costals and neural; sculpture coarse, with welts ..... *serialis*
2. Sculpture coarse, especially on proximal ends of the costals, but without welts. Anterior border of hyoplastron concave ..... *amnicola*

A^3. Bridger species:
1. See A^2, 1 ..... *serialis*
2. Nuchal sutured to first costals; welts not conspicuous; 5 to 7 pits in 10 mm. .... *trepida*

3. Carapace oval, not so wide as long, archt; nuchal about half the width of carapace; pits of costals small and shallow; hinder end of carapace with longitudinal welts ..... *trionychoides*
4. Carapace as broad as long; nuchal hardly half the width of the carapace; a smooth band along its front; sculpture coarse near midline..... *heteroglypta*
5. Carapace broader than long; nuchal more than half the width of carapace; pitted to free border; sculpture as in preceding..... *postera*
6. Carapace broader than long; nuchal not half the width of the carapace; sculpture like that of *heteroglypta*..... *extensa*

A^4. Oligocene species:

1. Carapace thin, broader than long; nuchal 0.6 the width of the carapace; a fontanel each side of first neural..... *leucopotomica*

A^5. Pliocene and recent species:

1. Carapace elliptical; longer than wide; nuchal about half the width of the carapace; sculpture rather coarse..... *ferox*

Platypeltis antiqua Hay.

Fig. 693.

Platypeltis antiqua, Hay, Bull. Amer. Mus. Nat. Hist., xxiii, 1907, p. 859, fig. 18.

The specimen which represents this species appears to have been collected for Professor Cope by Mr. D. Baldwin, in 1883, in the Torrejon beds of northern Mexico. It presents wholes or parts of 5 pairs of costals and 5 neural bones. Some other bones are buried in the very refractory matrix. The catalog number is 1036.

Neural.	Length.	Width.
2	14	10
3	16	9
4	15	8
5	12	6

The carapace (fig. 693) had a length of about 100 mm. and a width of 78 mm.; but the ends of the ribs extended beyond the disk at least 18 mm. What is evidently the first costal is 20 mm. long, from neural to distal end, and 13 mm. fore and aft. Its anterior border is smooth, showing that it was not suturally joined to the nuchal. The table shows the dimensions of the neurals present. They are from 2.5 mm. to 3 mm. thick.

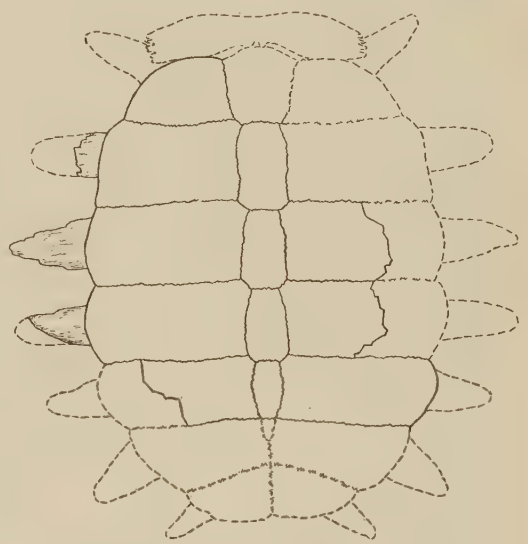


Fig. 693.—*Platypeltis antiqua*. Carapace of type. $\times\frac{2}{3}$.

The surface of the costals presents no welts, but is everywhere pitted. On the proximal ends of the costals there are 6 pits in a 10 mm. line; on the outer ends, 5 pits.

Platypeltis serialis (Cope).

Plate 98, fig. 13; plate 109, figs. 1–4; text-figs 694–696.

Trionyx, Leidy, Contrib. Ext. Vert. Fauna West. Terrs., 1873, p. 180, plate xvi, fig. 11.
Plastomenus ?thomasii, Cope, Syst. Cat. Vert. Eocene, New Mexico, 1875, p. 35.
Plastomenus thomasii, Cope, Wheeler's Surv. W. 100th Merid., iv, 1877, p. 49. (Not *Trionyx thomasii* Cope, 1872.)
Plastomenus thomasi, Cope, Vert. Tert. Form. West, 1884, p. 125. (Not *Trionyx thomasii* Cope, 1872.)
Plastomenus serialis, Cope, Wheeler's Surv. W. 100th Merid., iv, 1877, pp. 48, 51, pl. xxv, figs. 8–10; Vert. Tert. Form. West., 1884, p. 123.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1903, p. 453.
Platypeltis serialis, Hay, Amer. Geologist, xxxv, 1905, p. 337.

The types of the present species appear to have been lost. We must, therefore, depend for the identification of the species on the author's description and illustrations. Professor Cope possest fragmentary remains of five individuals, which he had obtained from the Wasatch

deposits of New Mexico. His figures represent fragments of 3 costal plates. He states that the species is readily distinguisht by the closely placed subparallel ridges which cross the ribs parallel to the axis of the body and which are separated by one or two rows of imprest dots, or small fossæ.

The costals varied in width from 18 mm. to 27 mm. and in thickness from 3 mm. to 5 mm. Three and a half ridges occupied a space of 9 mm.

The American Museum of Natural History expedition of 1903 to the Bridger beds in the region about Fort Bridger, Wyoming, secured a large portion of the carapace and a considerable part of the plastron of a specimen which it appears necessary to refer to Cope's Wasatch species. When, however, more satisfactory materials of the latter have been secured, it may prove that the Bridger remains belong to an unnamed species.

Cope's assignment of his materials to the genus *Plastomenus* depended on no part of the plastron, and was therefore inconclusive. There is reason to believe that the Bridger specimen does not belong to *Plastomenus*, but must be assigned to *Platypeltis*. It bears the catalog number 6014.

Of the individual here described (plate 98, fig. 13) there are present most of the first neural and the whole of the third; practically all of the 6 anterior costal plates, and a fragment of the seventh; the mesial half of the right hyoplastron and hypoplastron; and somewhat more of the mesial half of the same bones of the left side.

It is evident that the nuchal of this individual had no sutural connection with the costals of the anterior pair; whether or not it had such connection with the first neural is made doubtful by the fact that the anterior portion of this bone is missing. The hinder border of the carapace being gone, as well as the nuchal, the length can not be determined. From the front of the first costal to the hinder border of the sixth is 95 mm. Judging from the curve of the free borders of the sixth costals, but a few millimeters, perhaps 10 mm., would have been added by the seventh costals. If now we add 10 mm. as the width of the nuchal, we shall have as the probable length of the carapace 105 mm. The width of the disk is 100 mm. How far the ribs projected beyond the disk can not be determined.

The first neural had a length of about 16 mm. and a width of 13 mm. The third has the same length, but is 12 mm. wide. Both are of hexagonal form, with the narrow end directed forward. The sixth neural was also of the same form, but had the narrow end directed backward. There was present a small seventh neural wedged in between the costals of the sixth and seventh pairs.

The third costals are 17 mm. wide near their outer ends, 3.5 mm. thick near the sutural borders, and 5 mm. thru the rib. Toward the outer ends of the costals the ribs become quite prominent on the inner surfaces of the former.

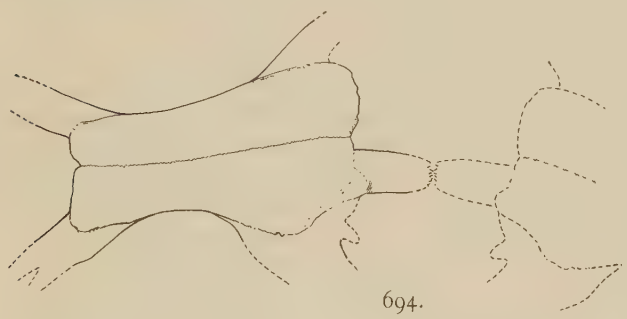
The ornamentation of the carapace agrees with that of Cope's *Plastomenus serialis*. There are on each side about 7 longitudinal ridges, or welts. These are low on the front of the shell but much more prominent posteriorly. Five of these ridges cross the sixth costal. Between the ridges there are from 1 to 3 rows of pits of varying sizes. On the neurals there are only small pits, or punctæ.

The plastron of this specimen, so far as represented, was like that of *Platypeltis spinifera*. The width of the hyoplastron (plate 109, fig. 3), where narrowest, is 7 mm.; that of the hypoplastron at the same place, is 10 mm. The inner end of the former bone expanded into a single flat process; that of the hypoplastron into two such processes. A callosity of 15 mm. width occupied these bones along their common suture, about half of it on each bone.

No. 5944 of the American Museum of Natural History, a specimen collected at Grizzly Buttes, Wyoming, in 1903, is referred to this species. It consists of portions of the carapace, the right hyoplastron and hypoplastron nearly complete, the median halves of the same bones of the left side, portions of the pectoral and pelvic girdles, and parts of the humerus and femur. These belonged to an older and larger individual than the one just described. The carapace (plate 109, fig. 4) is remarkable for the strong development of the longitudinal ridges; but it is not believed that a distinct species is indicated. One fragment belongs to the hinder rim of the carapace, and presents the seventh and eighth costals of the right side. The eighth costal was small. The plastron (plate 109, fig. 2; text-fig. 694) is in a more advanct stage of

growth than that of the specimen numbered 6014. The so-called callosities are much more extensive, a feature of age. They have a width of about 40 mm. The length of the hyo-hypoplastral suture is 74 mm.; the width of the bridge is 27 mm.; the thickness at the bridge, 7 mm. A comparison of the femur (fig. 695) with corresponding parts of *P. spinifera* appears to show that the shaft was nowhere so slender as in the living species, while the distal end was not so broad. The parts of the pelvis present display no important differences when compared with the pelvis of *P. spinifera*.

Mr. Paul Miller, of the American Museum of Natural History expedition of 1904, collected a nearly complete carapace (No. 3947) of a trionychid which the writer refers to this species. It is shown on plate 109, fig. 1; text-fig. 696. This came from the lower portion of the beds designated as C, and is therefore of later date than the Grizzly Buttes specimens. The striking feature in the carapace is the feeble development of the longitudinal ridges, or welts, the specimen presenting thus a great contrast to No. 5944. The ridges are moderately distinct on the last three pairs of costal plates, but farther forward they rapidly become obsolete. The pits are of the same size as in the other specimens and are separated by rounded walls.



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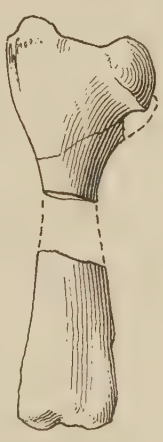

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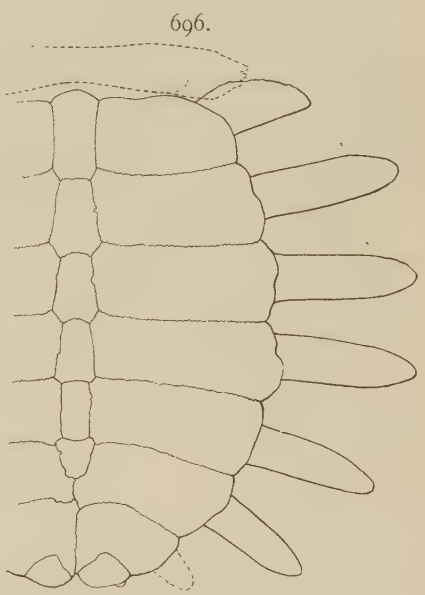


696.

FIGS. 694–696.—*Platypeltis serialis.*

694. Plastron. ×½.
695. Femur. ×1.
696. Carapace. ×½.

The nuchal of this specimen also is missing. It must have been very loosely attacht, just as it is in *P. spinifera*, even the first neural having its anterior border smooth. The left eighth costal is missing. The length of the specimen, as known, is 131 mm.; with the nuchal it was probably about 150 mm. The width of the disk, exclusive of the rib ends, is 105 mm.; but including these, it was about 175 mm. It must therefore have been a more elongated animal than *P. spinifera*. The great extension of the rib-ends beyond the disk shows that it was only of medium age.

The disk is rather flat, and was probably so during life. There are six neurals. The fifth comes into contact with only its own costals. The sixth is triangular and reduced in size. The costals of the eighth pair are small and hardly come into contact at the midline.

In the Vertebrata of the Tertiary Formations of the West, 1884, p. 126, Professor Cope, in discussing the genus *Plastomenus*, writes as follows: "The true *P. thomasii* was founded on sternal bone[s] perhaps of a small species of *Trionyx*." Since in the earliest description of

this species no plastral bones are mentioned, and in subsequent and more detailed descriptions the plastral bones mentioned are not Trionyx-like, we must regard the name *P. thomasii* as belonging to those specimens which were afterward called *P. multifoveatus*. In the Cope collection of reptiles in the American Museum of Natural History there are present the median ends of the right and left hyoplastra and a fragment of the left hypoplastron of a trionychid which are accompanied by Cope's labels, which read as follows: "*Plastomenus thomasii*, hyosternals" and "*Plastomenus thomasii*, sternum like *Trionyx*." The bones bear the number 1022, of the American Museum. It seems quite certain that these specimens are the alleged types of *P. thomasii;* but it is quite as certain that they have never been described. A comparison of them with the plastral bones of Bridger specimens of *Platypeltis serialis* proves that all belong to the same species, the resemblances between the hyoplastra of No. 1022 and No. 5944 being very close.

Platypeltis amnicola Hay.

Fig. 697.

Platypeltis amnicola, Hay, Bull. Amer. Mus. Nat. Hist. XXIII, 1907, p. 860, pl. liv, figs. 5, 6; text-fig. 19.

The incomplete and fragmentary remains which stand as the type of the present species were secured by the American Museum expedition of 1906 into the Wasatch beds of southwestern Wyoming. The specimen was found on Bitter Creek. There are present 2 neural bones, apparently enough fragments to restore nearly all the costals, most of the hyoplastron and hypoplastron of the left side and the inner ends of those of the right side. The catalog number is 6044.

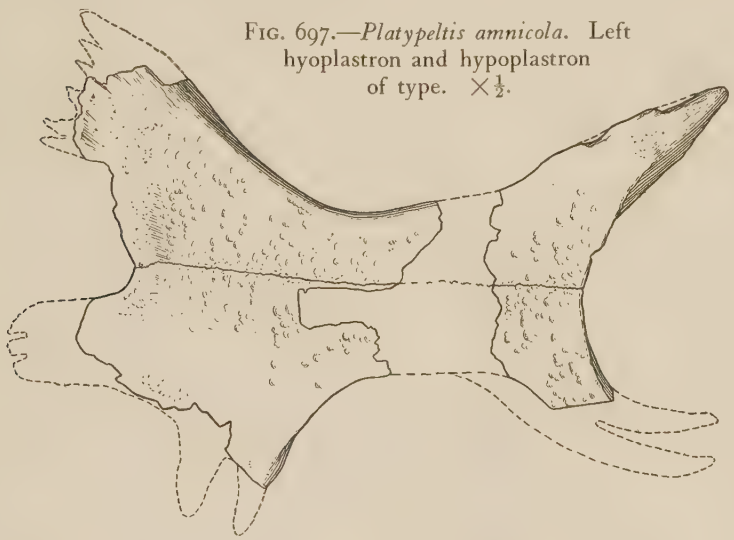


FIG. 697.—*Platypeltis amnicola*. Left hyoplastron and hypoplastron of type. $\times\frac{1}{2}$.

The carapace had a length of about 280 mm. and a width of 200 mm. or more. The species appears to have resembled *Platypeltis heteroglypta* of the Bridger beds.

What is regarded as the third neural is 35 mm. long, 25 mm. wide, and 6 mm. thick. One costal bone is 46 mm. wide at the distal end, while the sixth of the left side is 36 mm. wide distally. The eighth costal of the right side is present. It is small, and was evidently inclosed in a notch in the seventh costal. The free ends of all the costals are beveled off obliquely.

There appear to be no welts on the costals. The pits vary considerably in size. Near the distal ends the pits are arranged somewhat in rows parallel with the free border, and there are usually 6, sometimes 7, in a line 20 mm. long. Toward the proximal ends the pits increase in size so as to be two or three times as large as those of the distal ends. They are arranged more irregularly also.

The length of the suture between the hyoplastron and the hypoplastron (fig. 697) seems to have been close to 120 mm. The bridge is 45 mm. wide, and here the bones are 13 mm. thick. The lower surface of the bones, except the processes, is ornamented with ridges and pits. Of the pits there are usually 5 in a line 10 mm. long.

We may suppose that the plastron of *P. heteroglypta* resembled that of *P. postera*. That of *P. amnicola* differs much from that of *P. postera*, especially in having the anterior border of the hyoplastron concave, instead of nearly straight.

Platypeltis trepida Hay.

Fig. 698.

Platypeltis trepida, Hay, Bull. Amer. Mus. Nat. Hist. XXIII, 1907, pl. liv, fig. 7; text-fig. 20.

The single known specimen of this species was found by the American Museum expedition of 1906 into the Bridger beds of southwestern Wyoming. It was secured at Grizzly Buttes in the level designated as B. The catalog number is 5925.

The nuchal bone is wanting, as well as most of the costals of the right side and all the neurals except the fourth and the fifth. The original length of the specimen was close to 100 mm. The distance from the anterior border of the first costal to the hinder border of the fifth at its distal end is 77 mm. The breadth of the disk is 92 mm. Beyond this the ribs extended at least 15 mm.

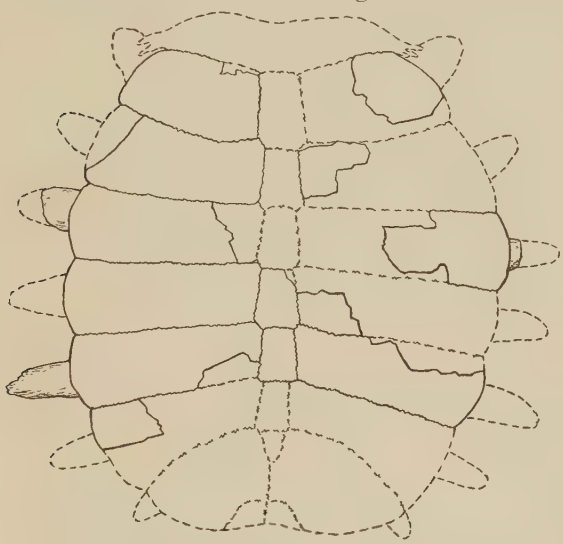


FIG. 698.—*Platypeltis trepida*. Carapace of type. $\times \frac{2}{3}$.

The fourth neural is 11 mm. long and 9 mm. wide. The fifth is 10 mm. long and 8 mm. wide. Each of these bones bears a low median keel.

The costals are thin, the thickness being about 2 mm. The first is 16 mm. wide; the second is 12 mm. wide at the distal end. The anterior border of the first shows that it was articulated by a jagged suture with the nuchal bone. The costals show some faint traces of longitudinal welts. The pits are mostly arranged in rows parallel with these more prominent ridges. There are from 5 to 7 pits in a line 10 mm. long.

The closer connection of the nuchal with the first costals, the finer sculpture, and the keel on the neurals distinguish this species from *P. serialis*.

Platypeltis trionychoides (Cope).

Plate 110, figs. 1–2; text-figs. 699, 700.

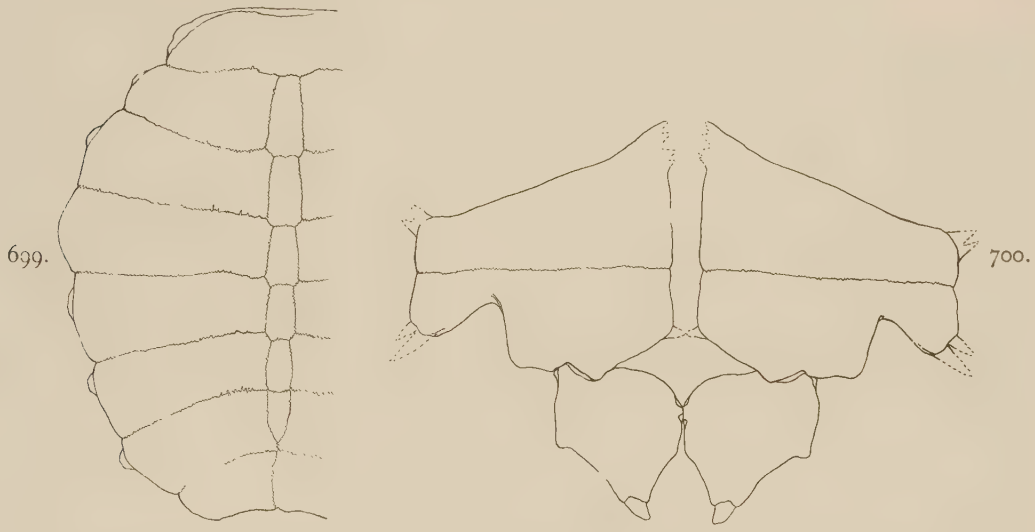
Anostira trionychoides, COPE, Proc. Amer. Philos. Soc., XII, 1872, p. 461.
Plastomenus trionychoides, COPE, Proc. Acad. Nat. Sci. Phila. 1873, p. 279; Ann. Report U. S. Geol. Surv. Wyoming, etc., 1872 (1873), p. 619; Vert. Tert. Form. West, 1884, p. 123, plate xviii, fig. 1.—HAY, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 453.
Platypeltis trionychoides, HAY, Amer. Geologist, XXXV, 1905, p. 336.

Professor Cope originally referred the present species to the genus *Anosteira*, a proceeding due, as he tells us, to the fact that the type specimens were found commingled with various bones of *Anosteira ornata* and all were supposed to belong to one species. When the error was discovered, the trionychoid bones were assigned to *Plastomenus*. The character of the sculpture doubtless determined this distribution of the species, for it does not appear that Cope possest any of the plastron. Cope's figured specimens of his species are now in the U. S. National Museum, but fragments of costal bones, bearing Cope's label stating that they are type specimens, are in the American Museum of Natural History. They are in all probability portions of the type which have become separated from the figured specimens. All of Cope's specimens of the species came from Cottonwood Creek, Wyoming, and hence from the level known as B.

Figs. 1 and 2 of plate 110 are reproduced from photographs of a nearly complete specimen of the species which was obtained by the American Museum expedition of 1903 into the Badlands of southwestern Wyoming. This specimen, which furnishes, besides the carapace, a large part of the plastron, both humeri, and both femora, was found at Grizzly Buttes. The number of the specimen in the American Museum is 5938. The length of the carapace along

the midline is 132 mm.; the extreme width is 117 mm. The carapace (fig. 699) is moderately convex. The anterior border is broadly rounded; the hinder border is excavated. There were originally 6 neural bones, of which the first is injured and the fourth is missing. The first had a length of 21 mm. and a width of 10 mm. The others are shorter and narrower. The nuchal has a fore-and-aft extent of 18 mm. and a length of 66 mm. from side to side. There are only 7 pairs of costals. Those of the seventh pair meet at the midline. The costals are about 3 mm. in thickness. The sculpture of the specimen agrees with that of the type, but it is more feebly developt. The surfaces of the neurals and the proximal ends of the costals present shallow pits arranged irregularly. Of these pits there are from 5 to 7 in a line 10 mm. long. Toward the distal ends of the costals the pits become smaller and more closely packt, there being about 10 in a 10 mm. line.

The greater portions of both hyoplastra and both hypoplastra accompany the carapace. There was a considerable fontanel between the hypoplastrals in front and the xiphiplastrals behind. The mesial half of the hyoplastra and of the hypoplastra are only 3 mm. thick; but the thickness is somewhat greater near the distal ends of the bones. The bridges are 26 mm. wide. The length of the hyohypoplastral suture is 61 mm. The sculpture of these bones is greatly like that of the carapace.



FIGS. 699 AND 700.—*Platypeltis trionychoides*. $\times\frac{1}{2}$.

699. Carapace of No. 5938 A. M. N. H. 700. Plastron restored from No. 5938 and No. 6017 A. M. N. H.

The limb bones present show no important differences when compared with those of *P. spinifera*.

No. 6017, of the American Museum of Natural History, was found at Grizzly Buttes in 1903. It furnishes fragments of the costals, some neurals, and nearly the whole of the plastron except the entoplastron and the epiplastra, elements of the plastron rarely recovered, on account of their loose attachment and their delicate construction. This specimen differs from the preceding only in the boldness of the sculpture, the pits being deeper and the ridges higher and sharper. It is coarsest on the outer ends of the hyoplastrals and the hypoplastrals. From this specimen has been drawn most of the plastron as represented in fig. 700, but parts of this figure have been taken from the plastron of No. 5938.

No. 5942, American Museum, also from Grizzly Buttes, belonged to a larger and an older individual than the specimens already described. The hyoplastron is co-ossified with the hypoplastron. Following the line of the missing suture, the distance is 92 mm. The bones are a little over 4 mm. thick on the mesial half; at the bridge they are about 8 mm. thick. The sculpture is strongly exprest, especially on the bridges.

The xiphiplastron differs in having the outer border, near the base of the process entering the hypoplastron, expanded outward. This is due probably to the greater age of the animal. The bone is 5 mm. thick; that of No. 6017 is 4 mm.

Platypeltis heteroglypta (Cope).

Plate 98, fig. 14; plate 101, fig. 2; text-figs. 701, 702.

Trionyx heteroglyptus, Cope, Proc. Acad. Nat. Sci. Phila. 1873, p. 277; U. S. Geol. Surv. Terrs., 6th Ann. Report, 1872, (1873), p. 616; Vert. Tert. Form. West, 1884, p. 120, plate xvi, fig. 2.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.
Platypeltis heteroglyptus, Hay, Amer. Geologist, xxxv, 1905, p. 336.

The type of this species is the hinder half of a carapace and the complete nuchal bone, which were collected in 1872, by Professor Cope, on the summit of Church Butte, Uinta County, Wyoming. This specimen is now in the American Museum of Natural History, New York, and bears the number 1039. Cope figured it, as above cited, and attempted to restore in outline the missing parts; but, as stated in the explanation of the plate, too few costals are represented. As there restored, the carapace is considerably broader than long, which almost certainly was not the case. Certainly 2, and possibly 3, costals come in front of the most anterior costal present, the fifth one from the rear. In the diagram here presented (fig. 701), the carapace is restored with 7 costals, the number present in the living American species of the family. There is a neural plate between the hindermost costals. These costals may be those of the eighth pair and the neural therefore the eighth; but an eighth neural is so seldom developt (*Amyda æqua*) that it is more probable that this is the seventh neural and the costals those of the seventh pair. For this reason the species is referred to the American living genus *Platypeltis*.

Cope has represented the distal end of the fifth costal from the rear as being drawn in farther than the specimen justifies. In fact, its free margin stood out nearly as far as did that of the next one behind.

Professor Cope did not know of the nuchal, it having been found, since the specimen came into the American Museum, lying in the matrix beneath the hinder end of the carapace. Its antero-posterior breadth, in the midline, is 26 mm.; its length, from side to side, about 120 mm. It is therefore rather small for a turtle of the size. This nuchal articulated with the first neural and probably with the anterior costals without fontanels. The upper surface is sculptured on the anterior edge for 26 mm. on each side of the midline. Beyond this, the surface is devoid of ornamentation. At the ends of the sculptured area the thickness is 10 mm. The outer ends of the nuchal were partially overlapt by the outer ends of the first pair of costal plates.

The carapace was possibly quite flat, but more probably it had considerable convexity. There is a narrow, but rather deep notch in the hinder margin of the carapace, at the midline. The measurements given in Cope's description are correct. The greatest width is 250 mm., taken between the distal ends of the fourth pair of costals from the rear. The distance from the rear of the shell to the anterior border of the most anterior costal present is 162 mm. The total length of the shell may be estimated at from 250 mm. to 280 mm. The thickness of a costal plate near its sutural border is 6 mm. The ribs stand out conspicuously on the under side of the plates, and thru them the thickness amounts to 10 mm. Cope states that the free portion of the costal is short. This probably refers to the projection of the rib beyond the plates. The rib of the penultimate costal is present and projects at least 33 mm. The hindermost pair of costals join along the midline for 25 mm. The neural which is lodged between the front borders of the hindermost costals is 14 mm. long and just as wide. The next neural in front seems to have been 24 mm. long and about 14 mm. wide. Its broader end is directed forward, and its anterior angles come into contact with the antepenultimate costals. A portion of the antepenultimate neural is present and appears to have had about the same width as the ones behind it. Its length was about 25 mm., and it has lain wholly between the costals of the antepenultimate pair, coming into contact with neither the pair in front nor that behind. Its hinder end has been slightly broader than the front end. Only a fragment of the neural next in front of the one just described is present. Its broader end has been directed backward and this has come into contact with the antepenultimate costals. The first neural has had a convex anterior border to fit the concave border of the nuchal.

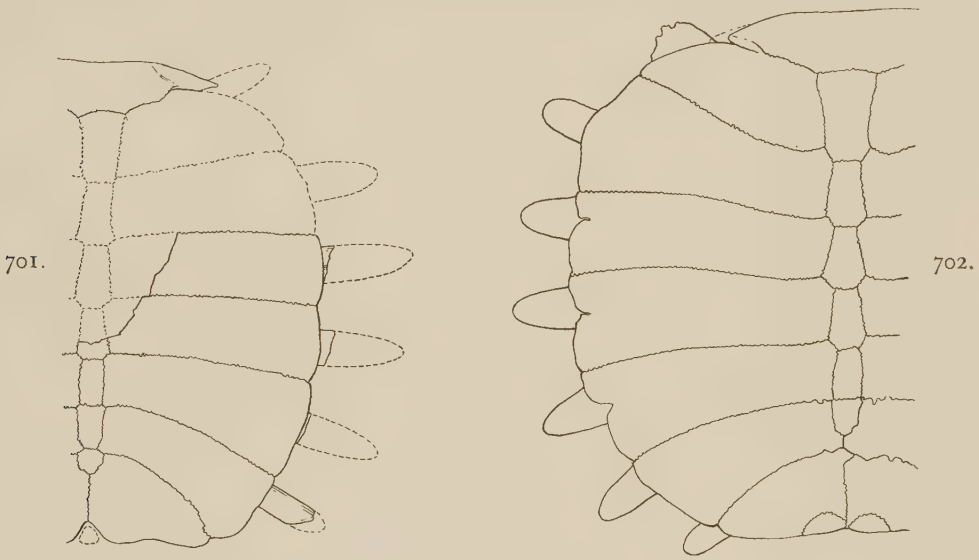
The sculpture of the different parts of the shell varies greatly. On the proximal ends of the hindermost costals it is coarse and consists of longitudinal ridges, with some lateral spurs. In the middle of the length of the other costals there is a network of ridges inclosing pits which

are 3 mm. or less in diameter. On the outer ends of these costals the pits are even smaller, and are arranged more or less in rows across the costals. On the nuchal the pits are small and shallow.

To this species is referred the specimen represented by fig. 702. It was collected by the American Museum expedition into the Bridger deposits in 1903. The more exact locality is the eastern part of Grizzly Buttes, Wyoming. The number of the specimen is 5910.

Only small portions of the carapace are missing. The median region of the nuchal is gone, and the second and third neurals. There are 8 pairs of costal plates, but the eighth pair is vestigial and might therefore be missing in other individuals of the same species. The total length of the carapace is 286 mm., the width almost exactly the same. Originally the upper surface may have been about as convex as the carapace of *Platypeltis ferox*, of Florida.

There is no preneural. The length of the first neural is 50 mm.; its width anteriorly, 31 mm., posteriorly, 16 mm. The fourth neural is 29 mm. long, 18 mm. wide. The fifth is 25 mm. long, 14 mm. wide. The sixth neural is pointed behind, 17 mm. long and of about the same width. It permitted the costals of the sixth pair to meet in the midline behind it. It is uncertain whether or not there was a small seventh neural.



FIGS. 701 AND 702.—*Platypeltis heteroglypta*. Carapaces. $\times \frac{1}{4}$.

701. Carapace of type. 702. Carapace of No. 5910 A. M. N. H.

The nuchal of this specimen is of greater extent fore and aft than in the type, being about 33 mm. The distal ends past beneath the border of the first costal plate, but apparently not beneath the rib of that costal. The free ends of the carapacial ribs projected beyond the margin of the shell about 27 mm.

The sculpture resembles closely that of the type specimen, consisting of large cells on the neurals and the proximal ends of the costals and of smaller cells on the distal ends of the costals. On the distal ends of the costals the cells are arranged somewhat in rows parallel with the adjacent border of the carapace.

Any possible doubts regarding the specific position of the specimen would arise from the fact that the nuchal is somewhat broader from front to back than in the type; that the costals are somewhat thinner, being only about 5 mm.; and that the free ends of the costals are beveled down to an acute edge, instead of being more or less obtuse as in the type. The distance from the hinder border of the carapace to the suture between the second and third costals is almost the same in the two specimens under consideration; but the width of the carapace of the recently acquired specimen is about 30 mm. greater than in Cope's type.

It is not believed that these differences indicate a distinct species. The thinness of the bones may be due to pressure during the early stages of fossilization; the greater width of the carapace to a more advanct age.

Platypeltis postera sp. nov.

Plate 111, figs. 1, 2.

The type of this species is No. 6133 of the American Museum. It was collected by the museum's expedition of 1905, at Sage Creek Springs, Wyoming, in deposits belonging to the level known as C, therefore somewhat above the level of the specimens of *P. heteroglypta*, its nearest relative. The length of the carapace (plate 111, fig. 1) in a straight line is 315 mm.; the greatest width, 342 mm. The upper surface is strongly convex from front to the rear and from side to side. This form is certainly natural. The nuchal is 39 mm. from front to rear, 182 mm. from side to side. There is no smooth band along its front. The 7 neurals are all present, and have the dimensions shown in the table. The seventh partly separates the costals of the seventh pair. Behind this these costals join along the midline a distance of 57 mm. The left one of the pair measures along the free hinder border 80 mm. The costals are thicker than in either of the specimens of *P. heteroglypta* but this may be due to its being an older individual. At their distal ends and near the suture they are 9 mm. thick. These ends are abruptly beveled or truncated.

Neural.	Length.	Width.
1	57	31
2	35	25
3	36	25
4	33	23
5	31	18
6	27	16
7	16	17

The sculpture is better displayed than in *P. heteroglypta*, No. 5910, but has the same general character. It differs, however, in that the ridges between the pits are narrower and sharper. It consists of pits, which are very large on the neurals and the proximal ends of the costals, much smaller on the distal ends of the costals and on the front of the nuchal. In the median region there are 3 pits in a line 13 mm. long. Occasionally they are slightly larger than this. On the distal ends of the costals there are about 5 pits in the line indicated.

The plastron (plate 111, fig. 2) lacks only the entoplastron, the epiplastra, and the outer ends of the right hyoplastron and hypoplastron. The form and relative size of the various bones may be determined from the plate. The hyoplastra are solidly co-ossified with the hypoplastra. The lower surface of all these bones is covered with the sculptured layer. Everywhere, except on the outer ends of the hyoplastra and hypoplastra, the pits are nearly obsolete. On the outer ends of the bones mentioned there are about 5 pits in a 15 mm. line. The line along which the hyoplastron and hypoplastron are united is 180 mm. The bridge is 64 mm. wide. The bones are about 12 mm. thick.

A specimen, No. 5955 of the American Museum, was collected in 1906 at Grizzly Buttes, Wyoming. It is smaller than the type; but the nuchal resembles that of the latter, having the sculptured layer covering the whole upper surface.

This species is certainly closely related to *P. heteroglypta*. The shell was probably more convex in life than that of the latter species. The bones are thicker and the free borders are more abruptly cut off than in *P. heteroglypta*. The nuchal is longer from side to side and there is no smooth band along the free border. Nor is there a smooth band of any considerable width on the free ends of the costals, as there is in both specimens of *P. heteroglypta*.

Platypeltis extensa sp. nov.

Plate 112; text-fig. 703.

The species here described is represented by only an imperfect carapace and plastron which were secured by the writer during the summer of 1903, in the Bridger deposits of the western part of Grizzly Buttes, Wyoming. When discovered the specimen was much broken. The fragments have been fitted together with all possible care, with the result that the form and the essential structure of the shell are revealed. A considerable area near the front of the carapace is yet missing; likewise a portion of the rear. The position and extent of the missing portions are shown by the figure on plate 112. The catalog number of the type is 5951 of the American Museum of Natural History.

In form the carapace is broader than long, with a broad and somewhat rounded front and a broadly truncated hinder end. The upper surface possest a moderate convexity, and this is probably not different from the form in life. The total length is 300 mm.; the width, 345 mm. Apparently there were present only 7 pairs of costal plates. Posteriorly the bone is present nearly to the midline; and in case there were 8 pairs of costals the posterior must

have been quite vestigial. The costals of the first pair are, at their proximal ends, much wider fore and aft than those behind them, being about 53 mm. wide, and they increase in width toward their distal ends. The third and fourth costals are narrow at their proximal ends, being respectively 36 mm. and 33 mm. wide, and they expand little toward the distal ends. The fifth and sixth are likewise narrow proximally, but they expand rapidly toward the margins of the carapace. The seventh costals extend on each side about 66 mm. from the midline.

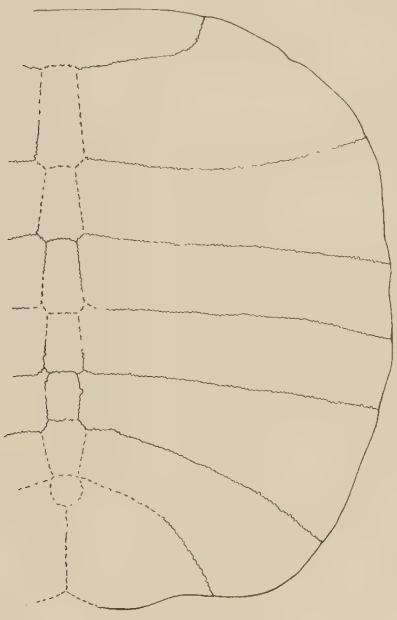


Fig. 703.—*Platypeltis extensa.* Carapace of type. $\times\frac{1}{4}$.

The free ends of the costal ribs extend little, if any, beyond the margins of the carapace, thus affording evidence that the individual was an aged one.

The carapace is thick and solid. Near the proximal ends the costals are 6.5 mm. thick and this thickness increases toward the margins of the carapace, where it amounts to 8 mm. in front and behind, and to 12 mm. and even 15 mm. at the sides. The borders of the carapace are not beveled off as in many species. Anteriorly and posteriorly the edge is rounded; at the sides the upper layer of bone overhangs the lower, and a groove runs along between them.

There was probably no preneural. The first neural is missing, but the proximal border of the left first costal indicates that the neural was long and narrow, with the narrower end forward. Only a fragment of the second neural remains. The third neural had a maximum width of about 23 mm.; the fourth a width of 20 mm.; the fifth a width of 17 mm. The more posterior neurals have not been preserved.

The nuchal bone is relatively small. Its lateral extent is 158 mm.; its fore-and-aft measurement, 29 mm. The outline of the anterior border is nearly straight, and the immediate edge is rounded and about 7 mm. thick.

The sculpture of *P. extensa* resembles closely that of *P. heteroglypta*, consisting of large pits, about two in a line 10 mm. long, on the neurals and the proximal ends of the costals, and of smaller cells, three in 10 mm., on the distal ends of the costals. The large pits have broad, low, and rounded walls surrounding them, while the walls of the smaller pits are more sharply defined. On the outer ends of the costals the pits show some tendency to arrange themselves in rows parallel with the margins of the carapace.

This species differs from *P. heteroglypta* in its greater breadth as compared with the length, and in the thickened and grooved lateral borders of the carapace.

The left hyoplastron and hypoplastron are complete, except the tips of the outer processes. The two bones are thoroly co-ossified. The sculptured layer, the callosities, extends to the midline. The length of the hyohypoplastral suture is 176 mm. The width of the bridge is 62 mm. Here the thickness of the hypoplastron is 11 mm. The hyoplastron is somewhat thinner. Near the inner end of the anterior border of the latter bone there is a deep notch for the entoplastron. At the hinder outer angle of the hypoplastron is a notch for a process of the xiphiplastron. The humerus differs only in details from that of *P. spinifera*. Its total length is 87 mm.

Platypeltis leucopotamica (Cope).

Plate 113, figs. 1–3; text-fig. 704.

Trionyx leucopotamicus, Cope, Contrib. Canad. Palæont., III (4 to), 1891, p. 5, plate i, figs. 8, 9.—Ami, Science (1), XVIII, 1891, p. 53.—Hay, Bibliog. and Cat. Foss. Vert. N. A., 1902, p. 454.
Trionyx punctiger, Cope, Contrib. Canad. Palæont., III (4 to), 1891, p. 5.—Hay. *loc. cit.*, p. 454.

The type of this species is a fragment of a costal plate 33 mm. long and 25 mm. wide, which was found in the White River deposits of the Cypress Hills, District of Alberta, British America. Professor Cope's description was reinforced by some fragments of what he regarded as the same species, which he had obtained in the White Buttes of North Dakota. One of

these fragments, a piece of a costal, was figured in the report above cited. The larger piece of costal which Cope figured belongs to the Geological Survey of Canada, and the present writer has been enabled to study it and compare it with the carapace to be here described.

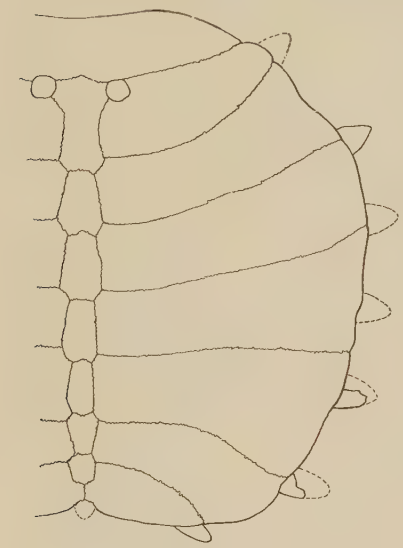


FIG. 704.—*Platypeltis leucopotamica.* Carapace. $\times\frac{1}{5}$. No. 6045 A.M.N.H.

In the collection of the American Museum of Natural History, there is the nearly complete carapace of a trionychid which is with confidence referred to Cope's species. This specimen, No. 6045 (plate 113; text-fig. 704) was found in the Titanotherium beds of the Hat Creek Basin, Nebraska, by Dr. J. L. Wortman, of the American Museum's expedition of 1894. This carapace was much fractured and required much skill and patience on the part of the preparator to restore it. Portions of the costals of the right side are missing; but the left side is complete, as well as the whole margin of the right side. It is possible that there were originally eight pairs of costals present, but the hinder border of the costals of the seventh pair appear to have a smooth edge, as if having formed a portion of the free border of the shell. As in *P. heteroglypta*, there is a neural between anterior borders of the costals of the last pair present, and there is a notch in the midline behind which may have lodged a small eighth neural. This region resembles much that of *Platypeltis spinifera*, of North America.

The carapace is broad, slightly concave in front, and slightly notcht behind. The bones are thin and light, indicating an animal that lived in quiet waters. This is likewise shown by the fineness of the matrix inclosing it.

The length of the carapace is close to 325 mm.; the greatest breadth is 353 mm. The shell is now quite flat, but it was originally probably moderately convex. The thickness of a costal plate at the sutural border and in the middle of the length is only 5 mm. or 6 mm.; but thru the rib it is 7 mm. or 8 mm. All around the border the shell is beveled off. The upper, or proximal, border of the bevel is concave, so that a broad, shallow groove runs around nearly the whole carapace. Nowhere does the sculptured layer overhang the deeper layers of the bone. Posteriorly the shell thins out to a blunt edge.

The ribs are very distinctly markt out on the lower side of the costal plates, and they occupy at least half of the width of each costal. They appear to have projected beyond the borders of the costal plates only about 15 mm.

The nuchal bone has a fore-and-aft extent of 38 mm., a transverse extent of 212 mm. At its outer border it overlaps the anterior edge of the first pair of costals.

There are present 7 neural plates. In general, these are broader behind than in front. The anterior is much larger than any of the others. There is no indication of a preneural. The front end of the first neural is broadest, and its anterior outer angles bound portions of 2 small fontanels which lie behind the nuchal. The fifth neural is quadrilateral, the sixth is coffin-shaped, with the broad end forward, and the seventh is hexagonal and short. The table gives the dimensions of the various neural plates.

Neural.	Length.	Width.
1	65	33
2	40	33
3	45	28
4	41	25
5	33	17
6	27	19
7	18	16

The distal ends of the various costals display considerable diversity in their widths; and in the specimen in hand those of the same pair differ in some cases on the opposite sides. These variations may be observed on plate 113.

The sculpture of this species varies within narrow limits in different parts of the carapace; as indeed it does in all species. Here, as in other cases, it is coarser on the hinder parts of the shell. In general, it agrees closely with the type specimen. It consists of squarish, roundish, or oval pits, inclosed by rather sharp ridges, which are narrower than the pits themselves. On the neurals and on a narrow strip on each side of these (plate 113, fig. 2), and again near

the outer ends of the costals (fig. 3 of plate 113), the pits arrange themselves more or less in rows parallel with the length of the animal. On an average there are about 8 pits in a line of 25 mm. Near the middle line posteriorly some of the pits may have twice the average size, but this is unusual. Along most parts of the sutural borders of the costals there is a strip which is almost devoid of sculpture, except some striations at right angles with the suture. This condition is most conspicuous on the proximal halves of the costals.

In a foot-note to the description of his *Trionyx leucopotamicus* Professor Cope has characterized a species, *T. punctiger*, from the White River beds of Billings County, North Dakota. One of the characters which are given to distinguish the latter from the former is the presence of a pitless band of surface along the sutural borders of the costals. That is present in the specimen which has here been described as *Platypeltis leucopotamica*, but the writer can not on that account assign it to *T. punctiger*. The latter species is said to have the ridges of the sculpture thickened and irregular and obscure on the outer ends of the costals. That is not true in the carapace above described. *T. punctiger* is said to have the shell thicker than that of *T. leucopotamicus*. Cope's type of the latter species has a thickness, thru the rib, of only 6 mm. The carapace here described from Nebraska has a thickness thru the ribs varying from 9 mm. to 11 mm., which is the thickness in the same regions of *T. punctiger*. It appears to the present writer that *T. punctiger* is identical with *T. leucopotamicus;* but more materials must be collected before certainty on this point can be obtained.

It is not known to the writer where the type of *T. punctiger* is.

Professor Cope in his description of this species spoke of its close resemblance to Leidy's *Trionyx uintaënsis*. Now that we have the complete carapaces of both species, it is seen that they are extremely different.

Platypeltis ferox (Schneider).

Trionyx ferox, Schneider, Schildkrote, 1783, p. 330; Boulenger, Catalogue Chelonians, 1889, p. 259.
Platypeltis ferox, Agassiz, Contrib. Nat. Hist. U. S., 1, pt. ii, 1857, p. 401.

In the Dr. Jarman collection of fossils obtained in Hillsboro County, Florida, and now the property of the Vanderbilt University, Nashville, Tennessee, there are several fragments of plastral and carapacial bones which the writer can not distinguish satisfactorily from corresponding bones of the above species, now living in the rivers of Florida. With these bones come others which evidently belong to 2 or 3 undescribed species of the genus; but the fragments hardly justify the application of systematic names to them. The beds furnishing these bones are supposed to belong to the Peace Creek formation.

Dr. Friedrich Siebenrock (Sitzber. Acad. Wien, math.-naturw. Cl., cxi, 1902, p. 829) regards this species as identical with *P. spinifera*. In fact the two forms are very distinct. *P. ferox* has the carapace much more elongated and the sculpture is much coarser. Their geographical distribution is different also.

THE END.

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PLATE 57.

1. *Pseudemys cælata.* Nuchal.
2. *Pseudemys cælata.* Fifth left costal.
3. *Pseudemys cælata.* Left third peripheral.
4. *Pseudemys cælata.* Left tenth peripheral.
5. *Pseudemys cælata.* Left hypoplastron.
6. *Pseudemys cælata.* Left first costal of smaller individual.

All figures slightly less than natural size. From type, No. 2508 U. S. N. M.

PLATE 58.

1. *Terrapene marnochi.* Carapace, side view. × 0.625. No. 3936 A. M. N. H.
2. *Terrapene marnochi.* Same carapace, upper view.

PLATE 59.

1. *Hadrianus majusculus.* Shell of the type. × 0.25. In Yale Univ. coll.
2. *Stylemys nebrascensis.* Skull, upper side. × 1. Princeton Univ. coll.
3. *Stylemys nebrascensis.* Same skull, lower side. × 1.
4. *Stylemys nebrascensis.* Egg. × 1. A. M. N. H.

PLATE 60.

Hadrianus corsoni. Carapace. × 0.375. No. 6027 A. M. N. H.

PLATE 61.

Hadrianus corsoni. Plastron. × 0.375. No. 6027 A. M. N. H.

PLATE 62.

1. *Stylemys nebrascensis.* Carapace. × 0.5. No. 1433 A. M. N. H.
2. *Stylemys nebrascensis.* Plastron of same shell. × 0.5.

PLATE 63.

1. *Stylemys capax.* Carapace of type. × 0.28. No. 1357 A. M. N. H.
2. *Stylemys capax.* Plastron of type. × 0.28.

PLATE 64.

1. *Stylemys conspecta.* Carapace of type. × 0.45. No. 1358 A. M. N. H.

PLATE 65.

1. *Testudo brontops.* Carapace of type. × 0.15. In Yale Univ. coll.
2. *Testudo brontops.* Plastron of type. × 0.15.

PLATE 66.

1. *Testudo thomsoni.* Front of plastron of type. × 0.5. No. 3940 A. M. N. H.
2. *Testudo thomsoni.* Skull of type, upper side. × 0.8.

3. *Testudo thomsoni.* Skull of type, lower side. × 0.8.
4. *Testudo thomsoni.* Skull of type, left side. × 0.8.
5. *Testudo thomsoni.* Lower jaw of type, left ramus. × 0.8.
6. *Testudo exornata.* Distal end of left fifth costal of type. × 0.8. Specimen in coll. Geol. Surv. Canada.
7. *Testudo exornata.* Same costal, inner surface. × 0.8.

PLATE 67.

1. *Testudo laticunea.* Carapace of type. × 0.28. No. 1148 A. M. N. H.
2. *Testudo laticunea.* Plastron of type. × 0.28.

PLATE 68.

FROM PHOTOGRAPHS FURNISHED BY CARNEGIE MUS., PITTSBURG.

1. *Testudo inusitata.* Carapace of type. × 0.5. No. 311 Carnegie Mus.
2. *Testudo inusitata.* Plastron of type. × 0.5.

PLATE 69.

FROM PHOTOGRAPHS FURNISHED BY DR. W. B. SCOTT.

1. *Testudo farri.* Carapace of type. × 0.375. No. 10486 Princeton Univ. coll.
2. *Testudo farri* Plastron of type. × 0.375.

PLATE 70.

1. *Testudo emiliæ.* Carapace of type. × 0.4. No. 6135 A. M. N. H.
2. *Testudo emiliæ.* Plastron of type. × 0.4.

PLATE 71.

1. *Testudo pansa.* Carapace of type. × 1/7. No. 5869 A. M. N. H.
2. *Testudo pansa.* Plastron of type. × 1/7.

PLATE 72.

Testudo osborniana. Carapace of type. × 0.2. No. 5868 A. M. N. H.

PLATE 73.

Testudo osborniana. Plastron of type. × 0.2. No. 5868 A. M. N. H.

PLATE 74.

Testudo osborniana. Carapace, limbs, head, neck and internal skeleton. × 0.2. No. 5870 A. M. N. H.

PLATE 75.

1. *Testudo osborniana.* Carapace. × 0.4. No. 5871 A. M. N. H.
2. *Testudo osborniana.* Plastron. × 04.

PLATE 76.

Testudo impensa. Carapace of type. × ⅙. No. 5867 A. M. N. H. The central portions are crushed inwards and d'sturbed.

PLATE 77.

Testudo impensa. Plastron of type. × ⅙. No. 5867 A. M. N. H.

PLATE 78.

1. *Testudo orthopygia.* Plastron of type. × 0.25. No. 3929 A. M. N. H.
2. *Testudo orthopygia.* Rear of shell. × ⅙. No. 1325 A. M. N. H.

PLATE 79.

1. *Testudo orthopygia.* Carapace. × 0.4. Mostly from No. 2415, but partly from Nos. 3931 and 2320 A. M. N. H. Represents young individuals called by Cope *Xerobates cyclopygia.*
2. *Testudo orthopygia.* Plastron. × 0.4. Mostly from No. 2415, but partly from No. 3931 A. M. N. H. Form called by Cope *Xerobates cyclopygia.*

PLATE 80.

1. *Testudo orthopygia.* Shell, side view. × 0.4. Restored from same specimens as figures of Plate 79.
2. *Testudo gilberti.* Skull of type, seen from above. × 0.75. From type in coll. Univ. Kansas.
3. *Testudo gilberti.* Same skull seen from below. × 0.75.
4. *Testudo gilberti.* Same skull, right side. × 0.75.
5. *Testudo gilberti.* Lower jaw of same skull. × 0.75.

PLATE 81.

Testudo orthopygia. Carapace. × 0.25. No. 6108 A. M. N. H.

PLATE 82.

Testudo orthopygia. Plastron. × 0.25. No. 6108 A. M. N. H.

PLATE 83.

FROM PHOTOGRAPHS FURNISHED BY CARNEGIE MUS., PITTSBURG.

1. *Testudo edæ.* Carapace of type. × 0.3. No. 1535 Carnegie Mus.
2. *Testudo edæ.* Plastron of type. × 0.3.

PLATE 84.

FROM PHOTOGRAPHS FURNISHED BY CARNEGIE MUS., PITTSBURG.

1. *Testudo hollandi.* Carapace of type. × ⅓. No. 1561 Carnegie Mus.
2. *Testudo hollandi.* Plastron of type. × ⅓.

PLATE 85.

1. *Plastomenus costatus.* Costal bone. Slightly reduced. No. 6131 A. M. N. H.
2. *Plastomenus costatus.* Right xiphiplastron. Slightly reduced. No. 6131 A. M. N. H.
3. *Plastomenus molopinus.* Carapace. × 0.6. No. 5941 A. M. N. H.

PLATE 86.

REPRODUCTION OF FIGURES BY COPE.

1. *Plastomenus catenatus.* Fragment of costal. × 1. No. 1138 U. S. N. M.
2. *Plastomenus? leptomitus.* Fragment of costal. × 1. No. 1113 U. S. N. M.
3. *Plastomenus? lachrymalis.* Fragment of costal. × 1. *a,* view of edge of fragment.
4. *Plastomenus? fractus.* Fragments of costals. × 1. Types lost. *w, x,* the proximal end of a costal, showing both surfaces; *y, z,* fragments of two costals.
5. *Plastomenus corrugatus.* Part of left hypoplastron. × 1. Original lost.
6. *Plastomenus communis.* Two peripherals. × 1. *a,* seen from above; *b,* view of edge. Type. No. 1132 U. S. N. M.
7. *Plastomenus communis.* Two peripherals of type. × 1.
8. *Plastomenus communis.* Fragment of hyoplastron of type. × 1.
9. *Amyda cariosa.* Neural. × 1. Type. No. 2575 U. S. N. M.
10. *Amyda cariosa.* Fragment of costal of type. × 1.
11. *Amyda radula.* Fragment of costal of type. × 1. No. 2581 U. S. N. M.
12. *Amyda radula.* Fragment of costal of type. × 1.

PLATE 87.

1. *Plastomenus visendus.* Carapace. × 0.5. Type. No. 1895 A. M. N. H.
2. *Plastomenus visendus.* Plastron of same specimen. × 0.5.

PLATE 88.

1. *Conchochelys admirabilis.* Skull of type, view from above. × ⅓. No. 6090 A. M. N. H.
2. *Conchochelys admirabilis.* Same skull, seen from below. × ⅓.
3. *Conchochelys admirabilis.* Same skull, seen from right side. × ⅓.
4. *Helopanoplia distincta.* Fragment of costal type. × 1. U. S. N. M.
5. *Helopanoplia distincta.* Portion of plastral bone of type. × 1. U. S. N. M.
6. *Aspideretes coalescens.* Fragment of costal. × 1. Shows the sculpture. From photograph furnished by L. M. Lambe.
7. *Aspideretes splendidus.* Portion of distal third of second costal of type. × 1. No. 3952 A. M. N. H. Shows character of sculpture.
8. *Aspideretes splendidus.* Portion of distal end of fourth costal of type. × 1.
9. *Aspideretes splendidus.* Portion of proximal half of third costal. × 1.

PLATE 89.

1. *Aspideretes foveatus.* Carapace. × 0.5. From photograph by L. M. Lambe. Specimen in coll. Geol. Surv. Canada.
2. *Aspideretes foveatus.* Right hypoplastron. × 1. From drawing by L. M. Lambe. Specimen in coll. Geol. Surv. Canada.

PLATE 90.

1. *Aspideretes coalescens.* Carapace. × 0.25. From photograph by L. M. Lambe. Specimen in coll. Geol. Surv. Canada.
2. *Aspideretes beecheri.* Carapace. × ¼. No. 2358 U. S. N. M.

PLATE 91.

Aspideretes splendidus. Carapace of type. × 0.28. No. 3952 A. M. N. H.

PLATE 92.

1. *Aspideretes beecheri.* Carapace and part of neck, limbs and tail of type. × 0.25. Specimen in Yale Univ. coll. Photograph by Wieland.
2. *Aspideretes beecheri.* Plastron of type. × 0.25. Photograph by Wieland.

PLATE 93.

1. *Aspideretes sagatvs.* Carapace of type. × ⅓. No. 1201 A. M. N. H.
2. *Aspideretes sagatus.* Portions of neurals and costals, to show sculpture. × 1. From type.
3. *Aspideretes sagatus.* Distal portion of a costal. × 1. From type.

PLATE 94.

1. *Aspideretes puercensis.* Carapace of type. × 0.5. No. 1202 A. M. N. H.
2. *Aspideretes puercensis.* Portion of first costal of type, taken near center. × 1.
3. *Aspideretes puercensis.* Portion of proximal end of third costal of type. × 1.

PLATE 95.

1. *Aspideretes ellipticus.* Carapace of type. × 0.4. No. 1117 A. M. N. H.
2. *Aspideretes ellipticus.* Portion of fifth neural and of fifth and sixth costals of type. × 1. To show character of sculpture.
3. *Aspideretes ellipticus.* Portion toward distal end of fifth costal of type. × 1.

PLATE 96.

1. *Aspideretes beecheri.* Portions of two costals of type, to show sculpture. × 1.
2. *Aspideretes beecheri.* Portion of costal to show sculpture. × 1. No. 2358 U. S. N. M.
3. *Aspideretes vagans.* Type fragment of costal. × 1. No. 1847 A. M. N. H.
4. *Amyda? halophila.* Neural and part of costal of type. × 1. No. 1476 A. M. N. H.
5. *Amyda? halophila.* Fragment of costal. × 1. No. 1476 A. M. N. H.
6. *Amyda? pennata.* Costal forming type. × 1. No. 1165 A. M. N. H.
7. *Amyda? virginiana.* Portion of costal of type. × 1. In coll. Maryland Geol. Surv.
8. *Amyda? virginiana.* Second portion of costal of type. × 1. In coll. Maryland Geol. Surv.

PLATE 97.

1. *Aspideretes grangeri.* Carapace of type. × 0.4. No. 3942 A. M. N. H.
2. *Amyda? prisca.* Proximal end of costal. × 1. No. 2401 A. M. N. H.
3. *Amyda? prisca.* Distal end of costal. × 1. No. 2401 A. M. N. H.
4. *Amyda? prisca.* Supposed part of nuchal. × 1. No. 2401 A. M. N. H.
5. *Amyda? prisca.* Supposed last costal. × 1. No. 2401 A. M. N. H.
6. *Amyda? prisca.* Portion of costal. × 1. No. 2401 A. M. N. H.

PLATE 98.

1. *Amyda ventricosa.* Distal end left hypoplastron of type. × 1. No. 1112 U. S. N. M.
2. *Amyda ventricosa.* Distal end of left hypoplastron of another individual. × 1. No. 1112 U. S. N. M.
3. *Amyda ventricosa.* Undetermined fragment of same lot.
4. *Amyda ventricosa.* Distal end of costal plate of same lot.
5. *Amyda ventricosa.* Portion of costal of small individual of same lot.
6. *Amyda ventricosa.* Fragment of costal of same lot.
7. *Amyda concentrica.* Fragment of costal of type. × 1. In A. M. N. H.
8. *Amyda concentrica.* Fragment of costal of type.
9. *Amyda concentrica.* Fragment of costal of type.
10. *Amyda concentrica.* Fragment of costal of type.
11. *Amyda lima.* Portion of costal forming type. × 1. In A. M. N. H.
12. *Amyda buiei.* Fragment of costal. × 1. In A. M. N. H.
13. *Platypeltis serialis.* Left half of carapace. × 1. No. 6014 A. M. N. H.
14. *Platypeltis heteroglypta.* Part of middle of fifth costal of type. × 1. No. 1039 A. M. N. H.

PLATE 99.

1. *Amyda æqua.* Carapace of type. × 0.31. U. S. N. M.
2. *Amyda æqua.* Third neural and costal of type. × 1.
3. *Amyda æqua.* Portion of middle of costal. × 1.

PLATE 100.

1. *Amyda uintensis.* Plastron of type. × 0.27. Coll. Phila Acad.
2. *Amyda scutumantiquum.* Right hyoplastron and hypoplastron of type. × 0.5. No. 1035 A. M. N. H.
3. *Amyda scutumantiquum.* Part of first and second neurals and first and second costals of type. × 1.
4. *Amyda scutumantiquum.* Part of distal end of a costal of type. × 1.

PLATE 101.

1. *Amyda scutumantiquum.* Carapace of type. × 0.3. No. 1035 A. M. N. H.
2. *Platypeltis heteroglypta.* Carapace of type. × 0.38. No. 1039 A. M. N. H.

PLATE 102.

Amyda franciscæ. Carapace of type. × 0.4. No. 5936 A. M. N. H.

PLATE 103

Amyda franciscæ. Plastron of type. × 0.4. No. 5936 A. M. N. H.

PLATE 104.

1. *Amyda salebrosa.* Carapace of type. × 0.3. No. 3941 A. M. N. H.
2. *Aspideretes puercensis.* Right hyoplastron and hypoplastron. × 0.6. No. 1202 A. M. N. H.
3. *Aspideretes puercensis.* Portion of right xiphiplastron of type. × 0.6.
4. *Axestemys byssina.* Left xiphiplastron. × 0.43. U. S. N. M.

PLATE 105.

1. *Amyda mira.* Carapace of type. × 0.5. No. 6130 A. M. N. H.
2. *Temnotrionyx manducans.* Part of right maxilla of type, side view. × 1. No. 5929 A. M. N. H.
3. *Temnotrionyx manducans.* Same maxilla, showing grinding surface. × 1.

PLATE 106.

Amyda mira. Plastron of type. × 0.7.

PLATE 107.

1. *Amyda egregia.* Carapace of type. × 0.4. No. 1186 A. M. N. H.
2. *Amyda egregia.* Part of fourth and fifth neurals and fourth and fifth costals. Type. × 1.

PLATE 108.

Amyda crassa. Carapace of type. × 0.32. No. 3887 A. M. N. H.

PLATE 109.

1. *Platypeltis serialis.* Carapace. × 0.75. In A. M. N. H.
2. *Platypeltis serialis.* Plastron. × 0.75. No. 5944 A. M. N. H.
3. *Platypeltis serialis.* Plastron. × 0.75. No. 6014 A. M. N. H.
4. *Platypeltis serialis.* Distal end of costals. × 1. No. 5944 A. M. N. H.

PLATE 110.

1. *Platypeltis trionychoides.* Carapace. × 0.75. No. 5938 A. M. N. H.
2. *Platypeltis trionychoides.* Plastron. × 0.75. No. 5938 A. M. N. H.

PLATE 111.

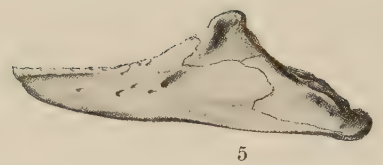
1. *Platypeltis postera.* Carapace of type. × 0.32. No. 6133 A. M. N. H.
2. *Platypeltis postera.* Plastron of type. × 0.32.

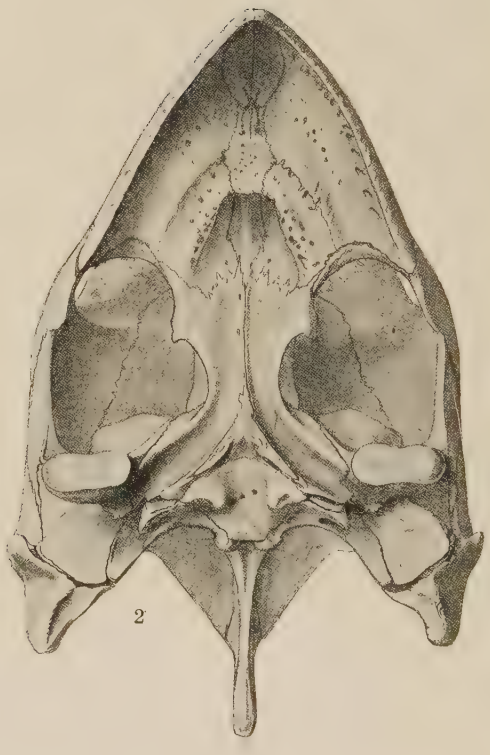
PLATE 112.

Platypeltis extensa. Carapace of type. × 0.4. No. 5951 A. M. N. H.

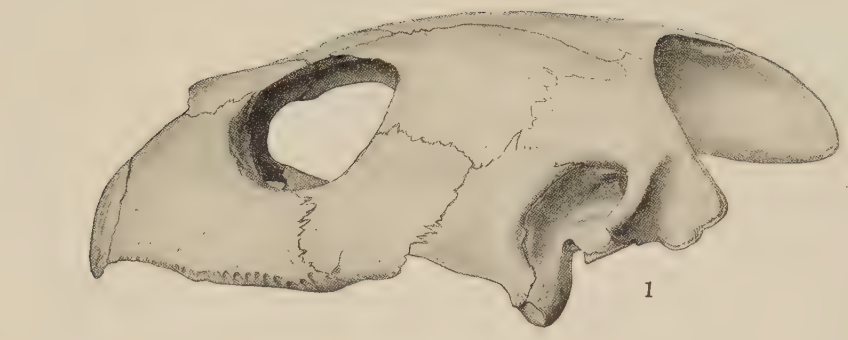
PLATE 113.

1. *Platypeltis leucopotamica.* Carapace. × ⅓. No. 6045 A. M. N. H.
2. *Platypeltis leucopotamica.* Part of third neural and costal. × 1. No. 6045 A. M. N. H.
3. *Platypeltis leucopotamica.* Distal end of second costal. × 1. No. 6045 A. M. N. H.





Figs. 1 to 4. Colpochelys kempi. × ⅔. Page 8.
Fig. 5. Platypeltis ferox. × ⅔. Page 11.



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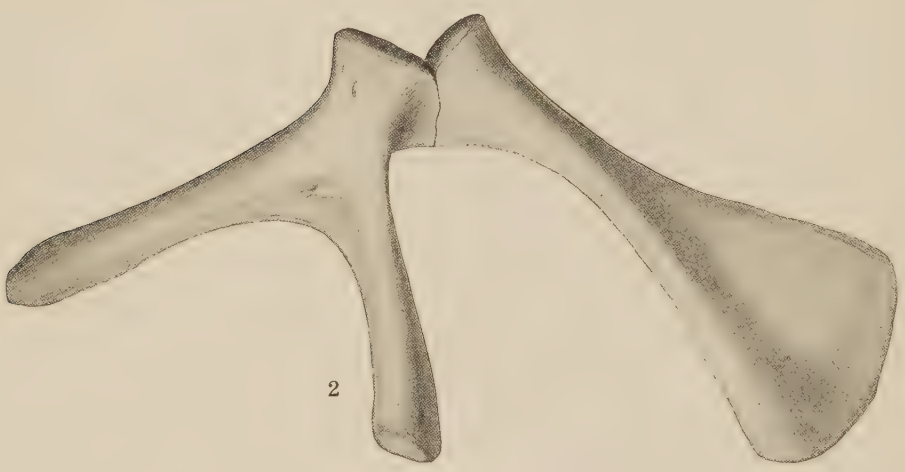

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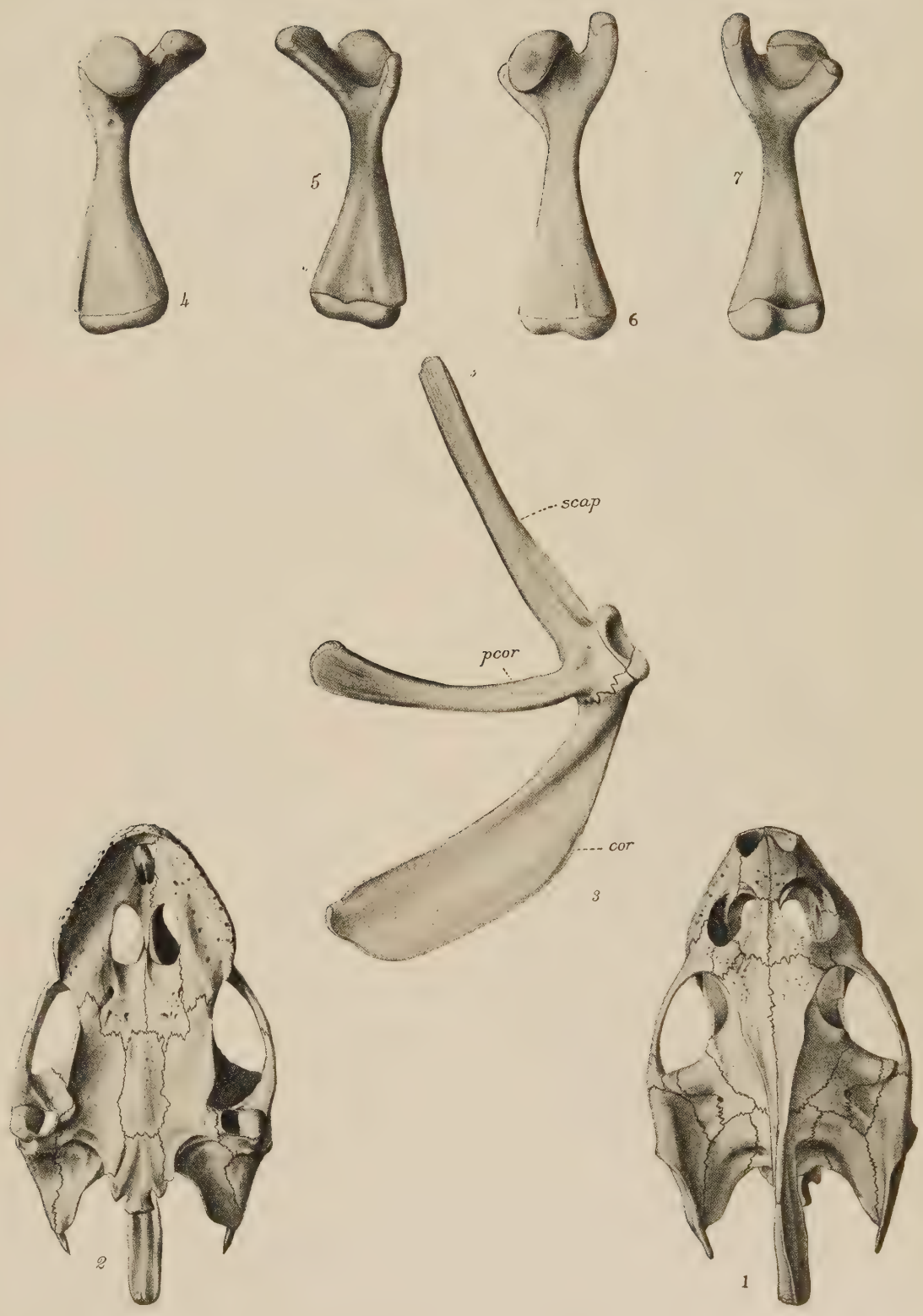
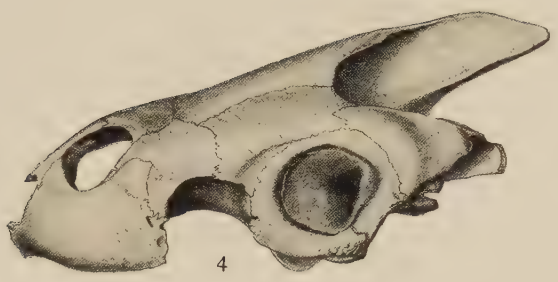
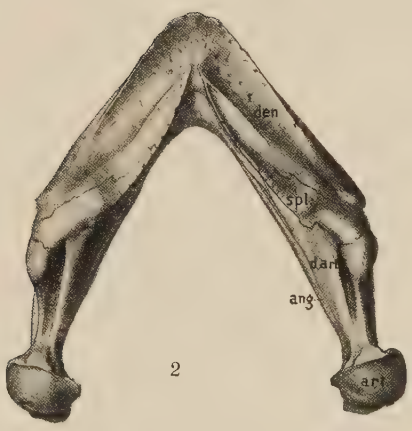
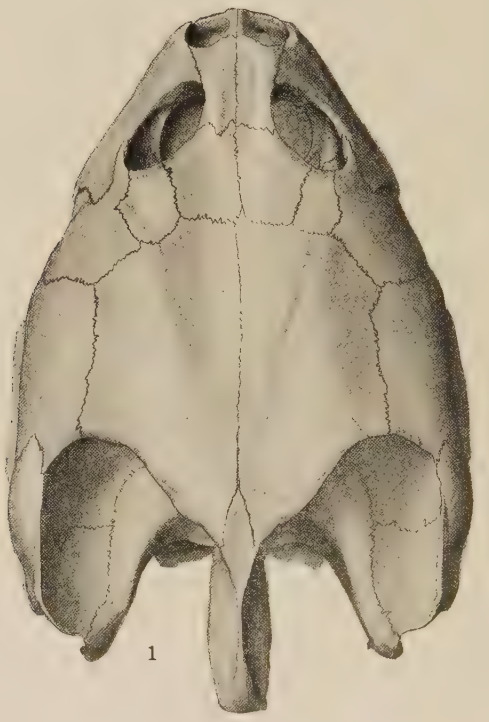
Colpochelys kempi. × ⅔. Page 8.



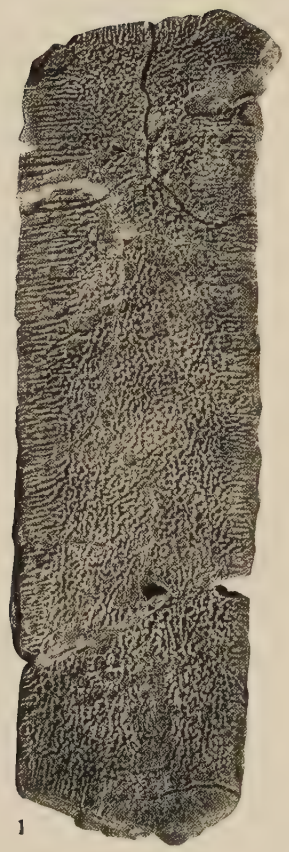
Platypeltis ferox. × ⅔. Page 11.







Podocnemis expansa. Figs. 1 and 2, $\times \frac{2}{3}$; Figs. 3, 4, and 5, $\times \frac{1}{2}$. Page 14.



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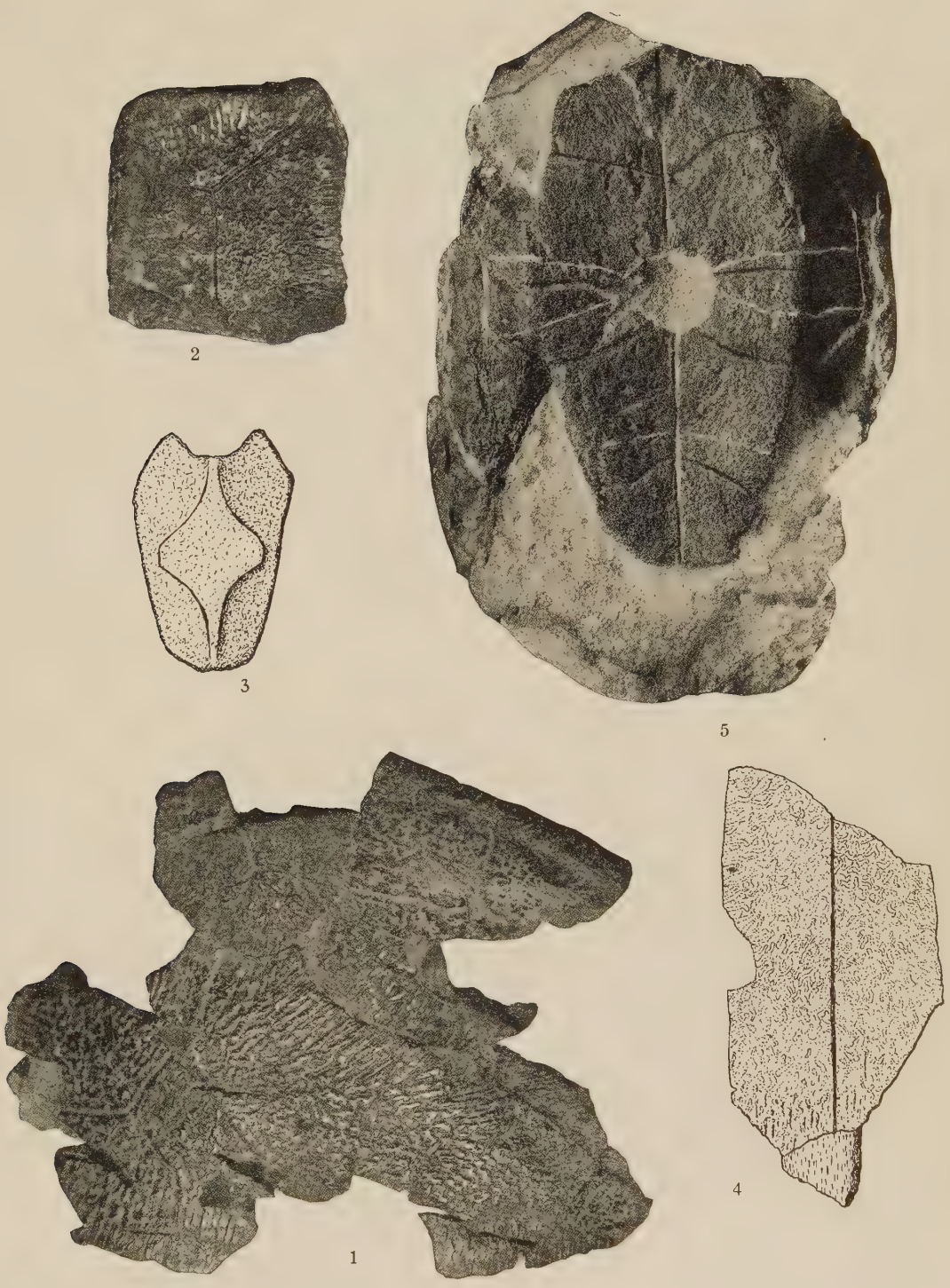
Glyptops plicatulus. Figs. 1 to 4, $\times$ 1; Fig. 5, $\times \frac{1}{4}$. Page 47.

Glyptops plicatulus. × ½. Page 47.



Figs. 1 and 2. Glyptops cælatus. × 1. Page 52.
Figs. 3 and 4. Glyptops? belviderensis. × 1. Page 53.
Fig. 5. Probaëna sculpta. × 1. Page 58.

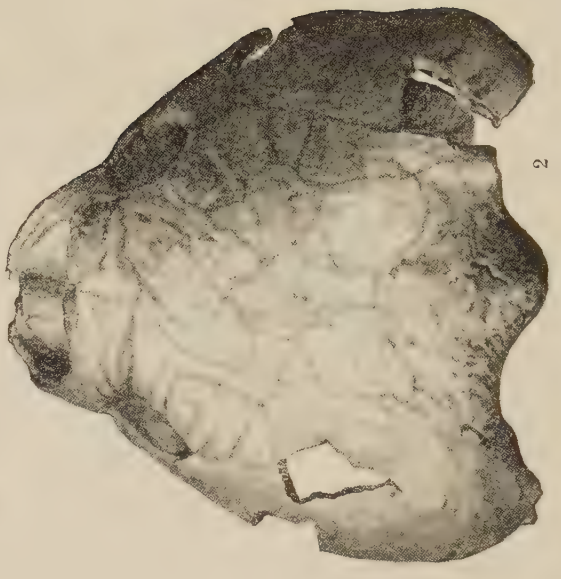
Fig. 1. Baëna callosa. × 0.6. Page 60.
Fig. 2. Baëna marshi. × 0.47. Page 62.

Baëna hatcheri. × $\frac{4}{7}$. Page 63.

Baëna hatcheri. × ⅔ Page 63.

Baëna escavada. × ¼. Page 65.

Baëna arenosa. × ½. Page 68.



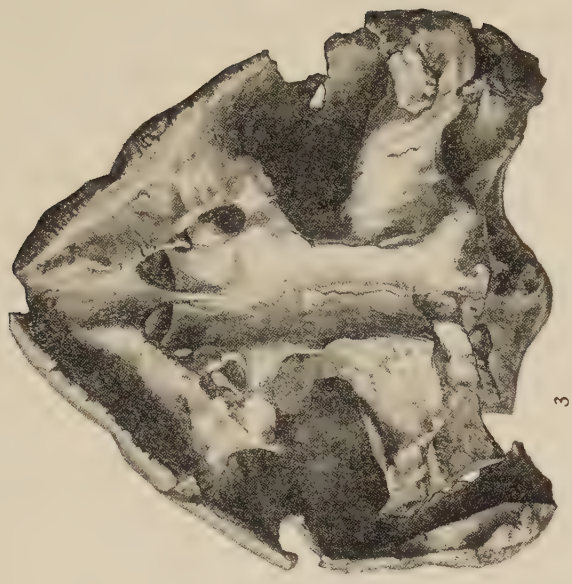


Fig. 1. Baëna arenosa. × 0.55. Page 68.
Figs. 2 and 3. Baëna sima. × 1. Page 72.

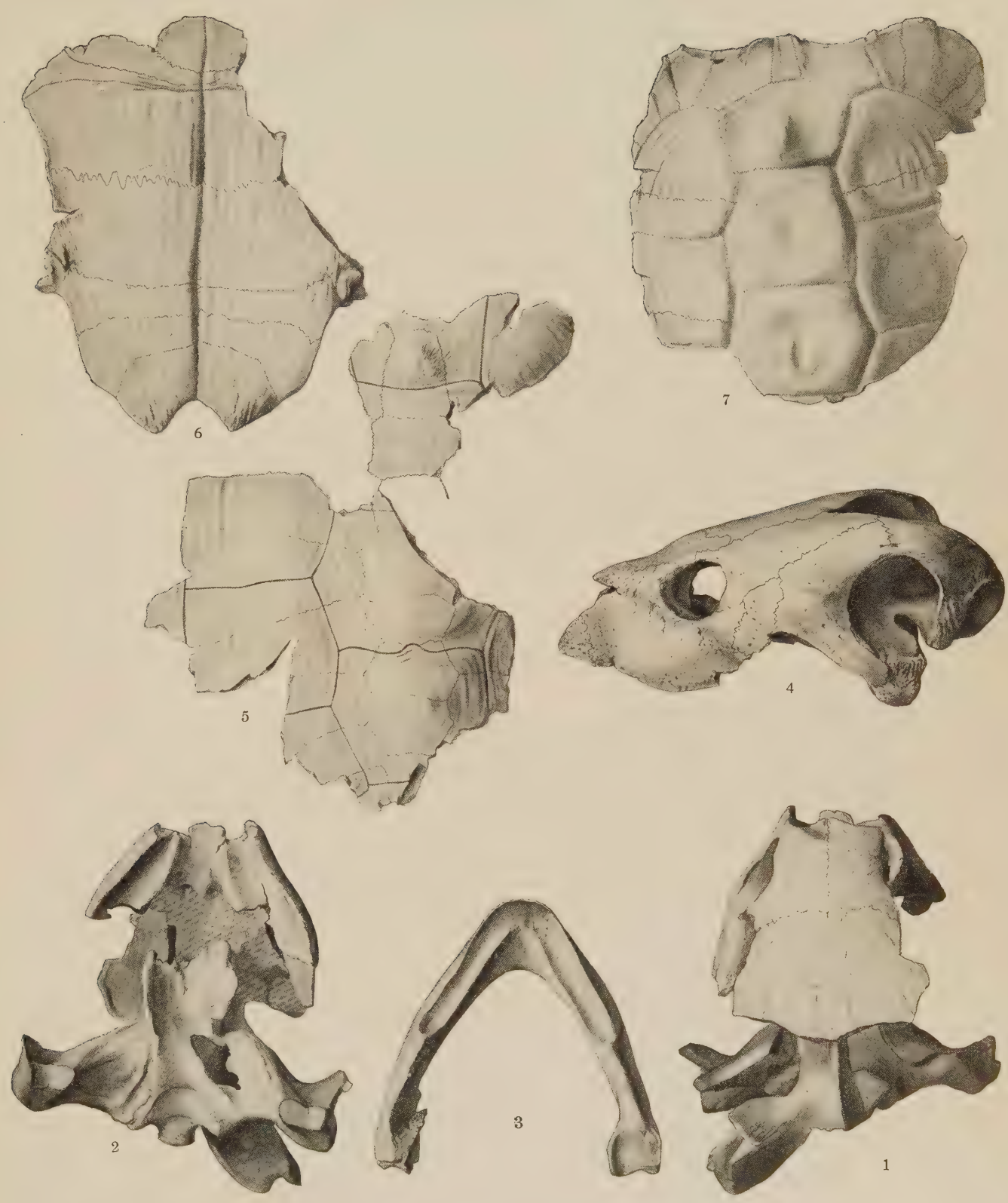
Figs. 1 to 3. Baëna arenosa. × 1. Page 69.
Figs. 4 to 6. Baëna sima. × 1. Page 72.

Baëna sima. × ½. Page 73.

Baëna clara. × ⅓. Page 74.

Baëna riparia. × ⅔. Page 76.

Baëna riparia. × ⅔. Page 77.



Figs. 1 to 3. Baëna riparia. × 1. Page 78.
Fig. 4. Eubaëna cephalica. × 1. Page 82.
Fig. 5. Testudo vaga. × ½. Page 415.
Figs. 6 and 7. Testudo orthopygia. × ⅓. Page 446.

1

2

Baëna emiliæ. × ⅓. Page 80.

Figs. 1 and 2. Eubaëna cephalica. × 1. Page 82.
Figs. 3 and 4. Chisternon hebraicum. × 1. Page 88.

Chisternon undatum. × 0.34. Page 85.

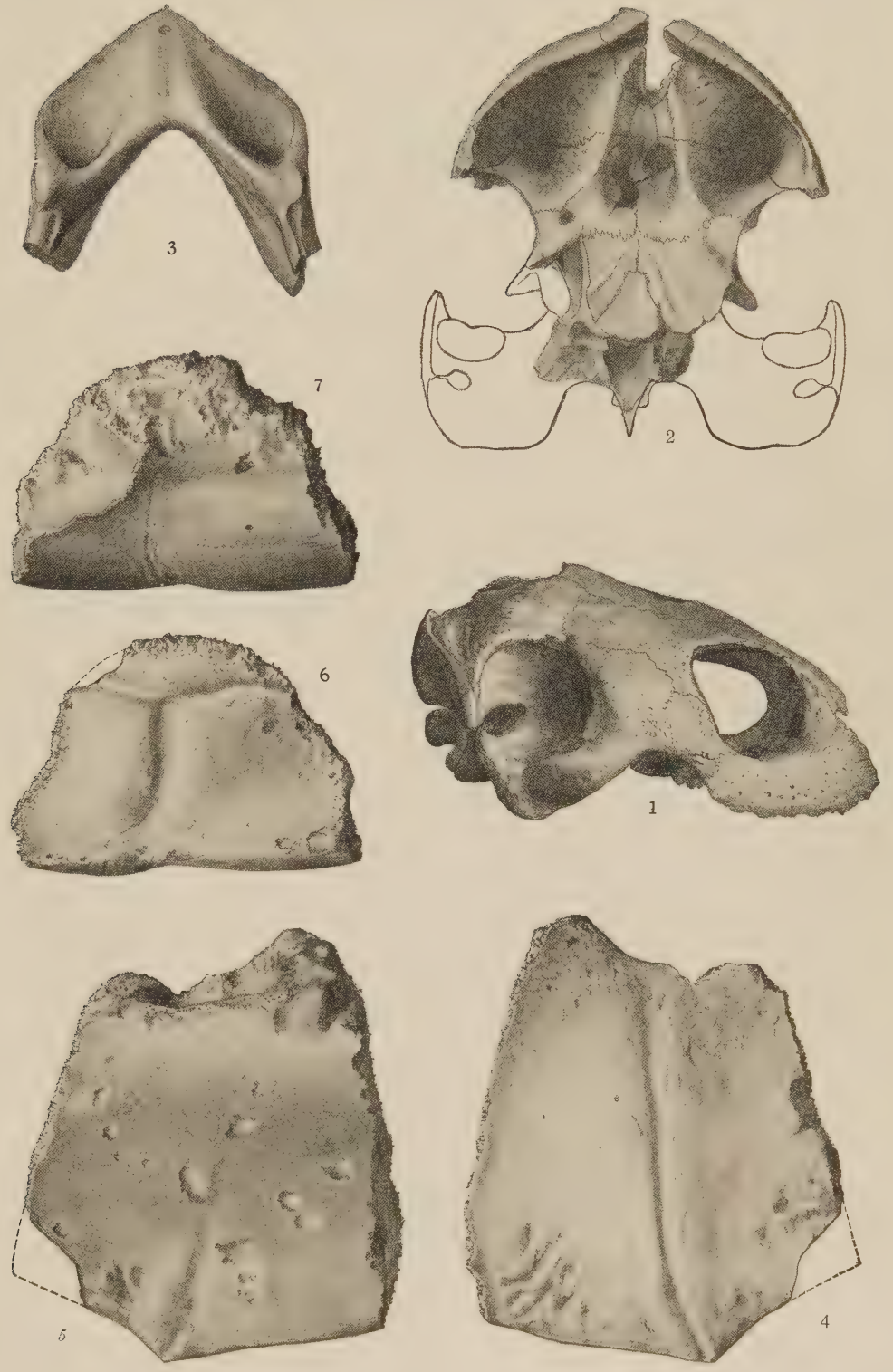


Fig. 1. Chisternon hebraicum. × 1. Page 88. Figs. 2 and 3. Bothremys cooki. × $\frac{4}{5}$. Page 103.
Figs. 4 to 7. Osteopygis chelydrinus. × $\frac{3}{4}$. Page 136.

Thescelus insiliens. × ⅓. Page 95.

Thescelus insiliens. × ⅓. Page 95.

Fig. 2. Osteopygis erosus. × 0.27. Page 139.
Fig. 3. Osteopygis borealis. × 0.27. Page 144.
Fig. 1. Osteopygis gibbi. × 0.23. Page 132.

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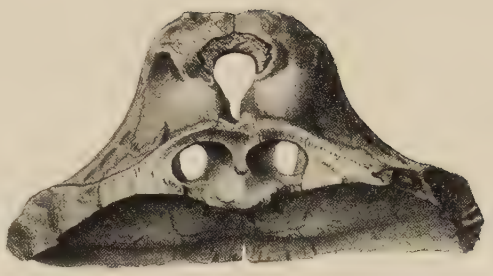
2

Osteopygis gibbi. × ¼. Page 132.

Figs. 1 to 4. Osteopygis chelydrinus. × ¾. Page 136.
Figs. 5 and 6. Lytoloma angusta. × ⅜. Page 155.
Figs. 7 and 8. Lytoloma wielandi. × ⅜. Page 157.



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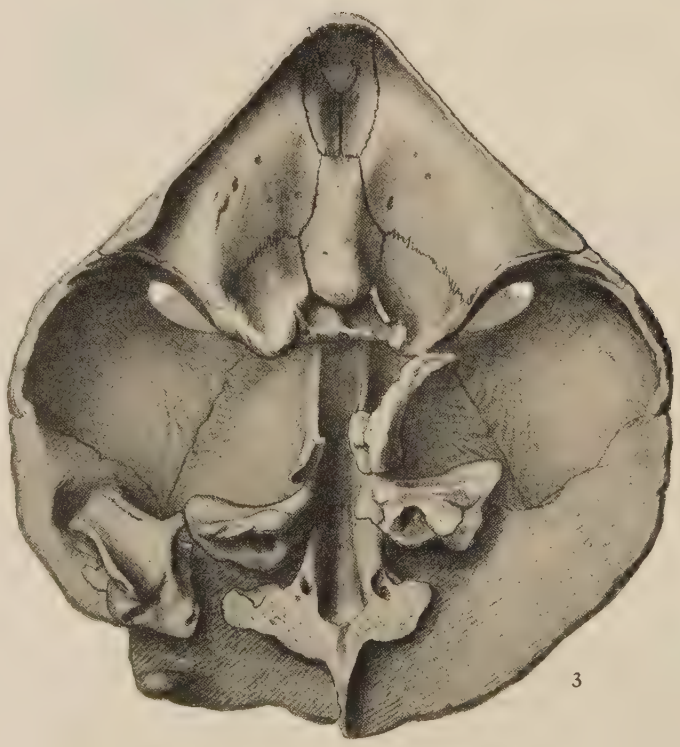

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Fig. 1. Lytoloma wielandi. × ⅔. Page 157.

Figs. 2 and 3. Rhetechelys platyops. × ⅔. Page 162.

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Toxochelys sp. indet. × ⅓. Page 164.

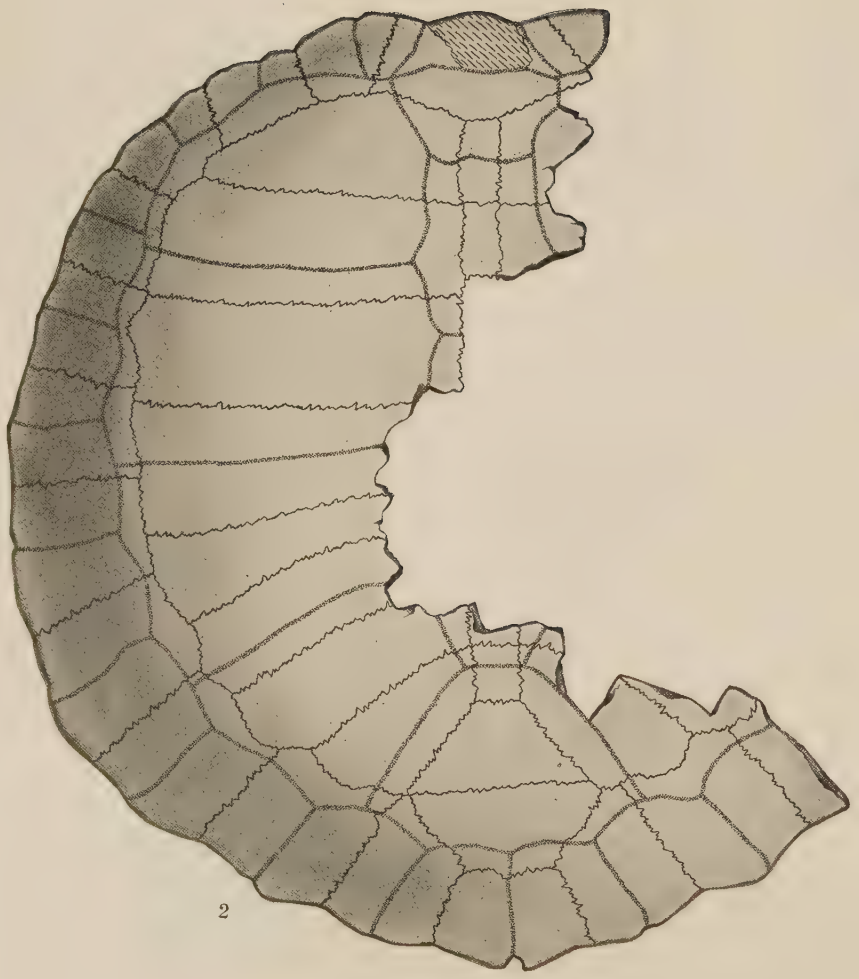
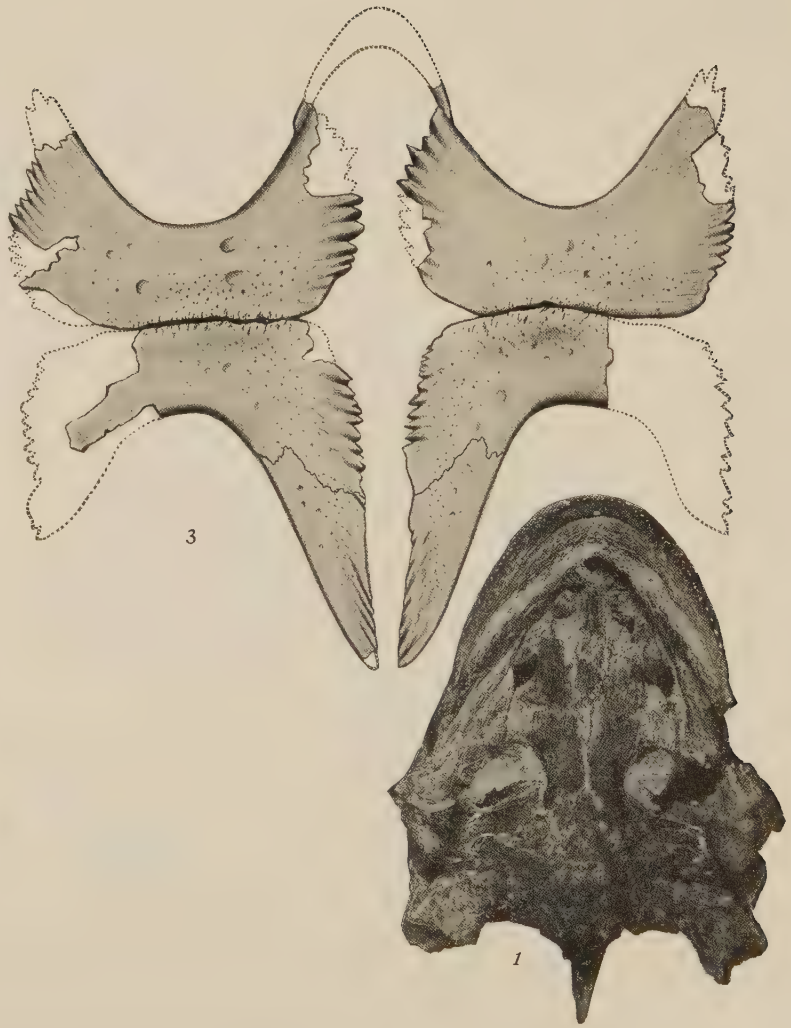
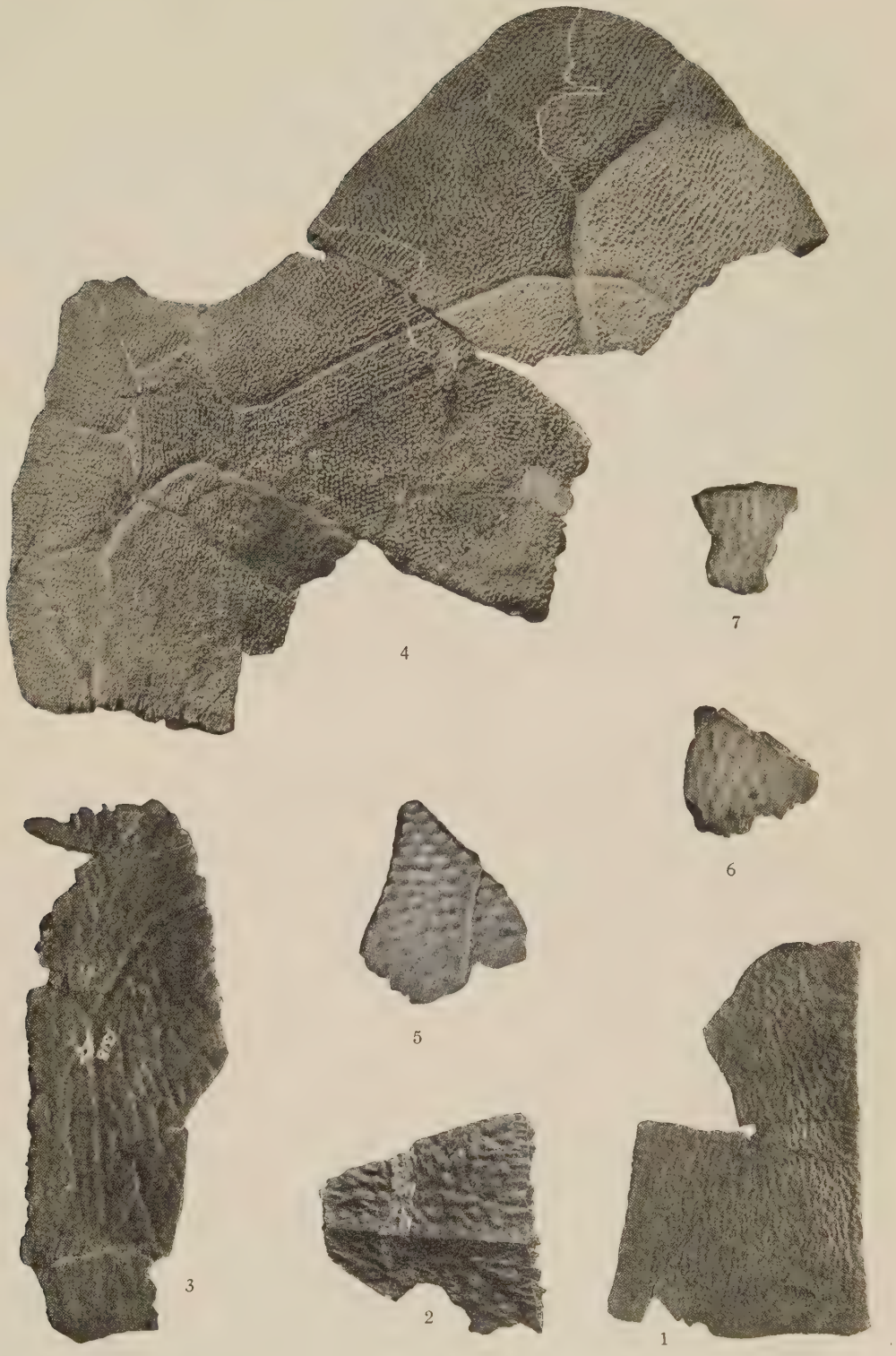


Fig. 1. Toxochelys brachyrhina. × ½. Page 171.



Figs. 2 and 3. Porthochelys laticeps. × ⅛. Page 180.



Figs. 1 and 2. Syllomus crispatus. × ⅔. Page 211.
Fig. 3. Chelonia? parvitecta. × ⅔. Page 220.
Fig. 4. Basilemys variolosa. × ⅓. Page 226.
Figs. 5 to 7. Basilemys imbricata. × 1. Page 231.

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Basilemys sinuosa. × ½. Page 229.

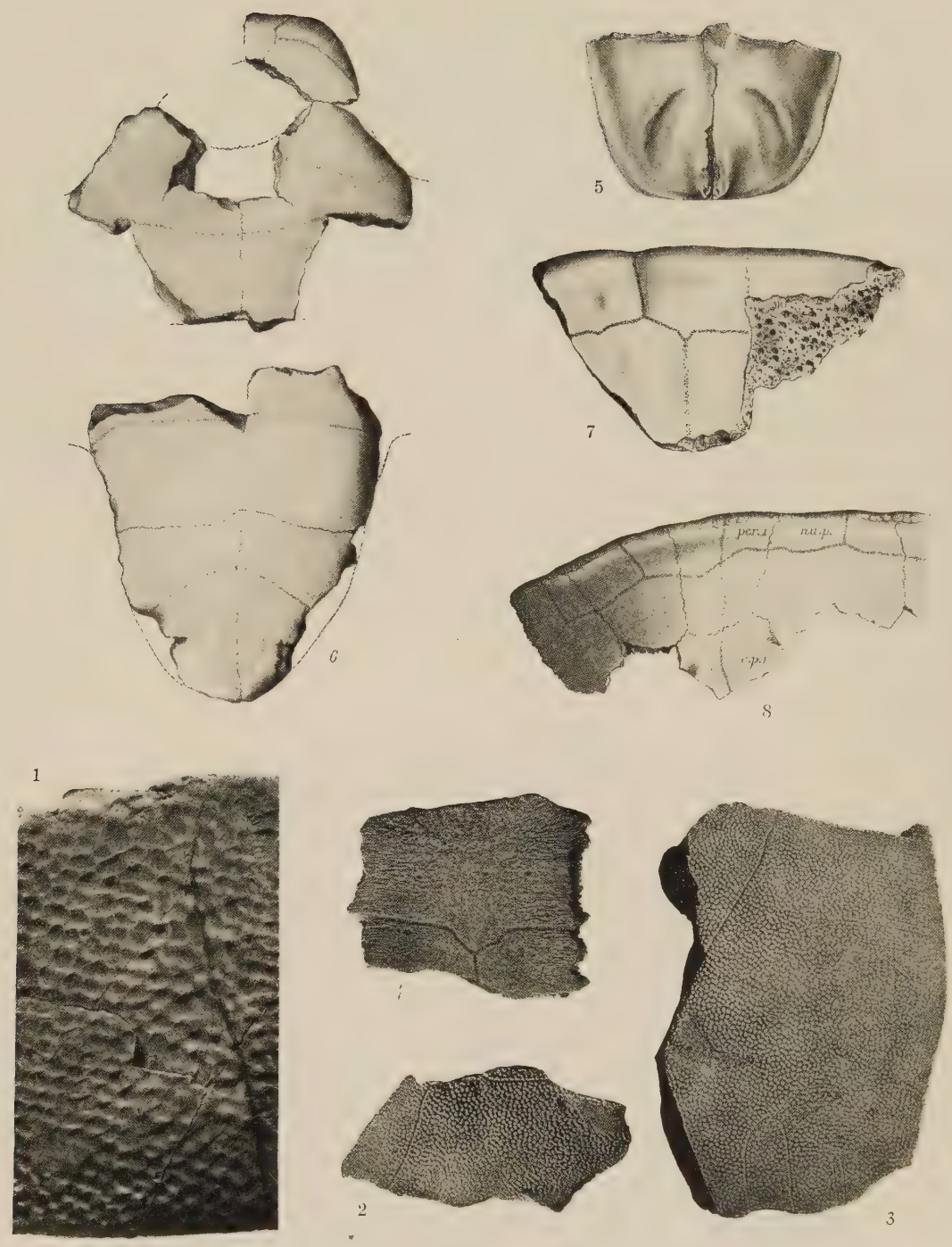
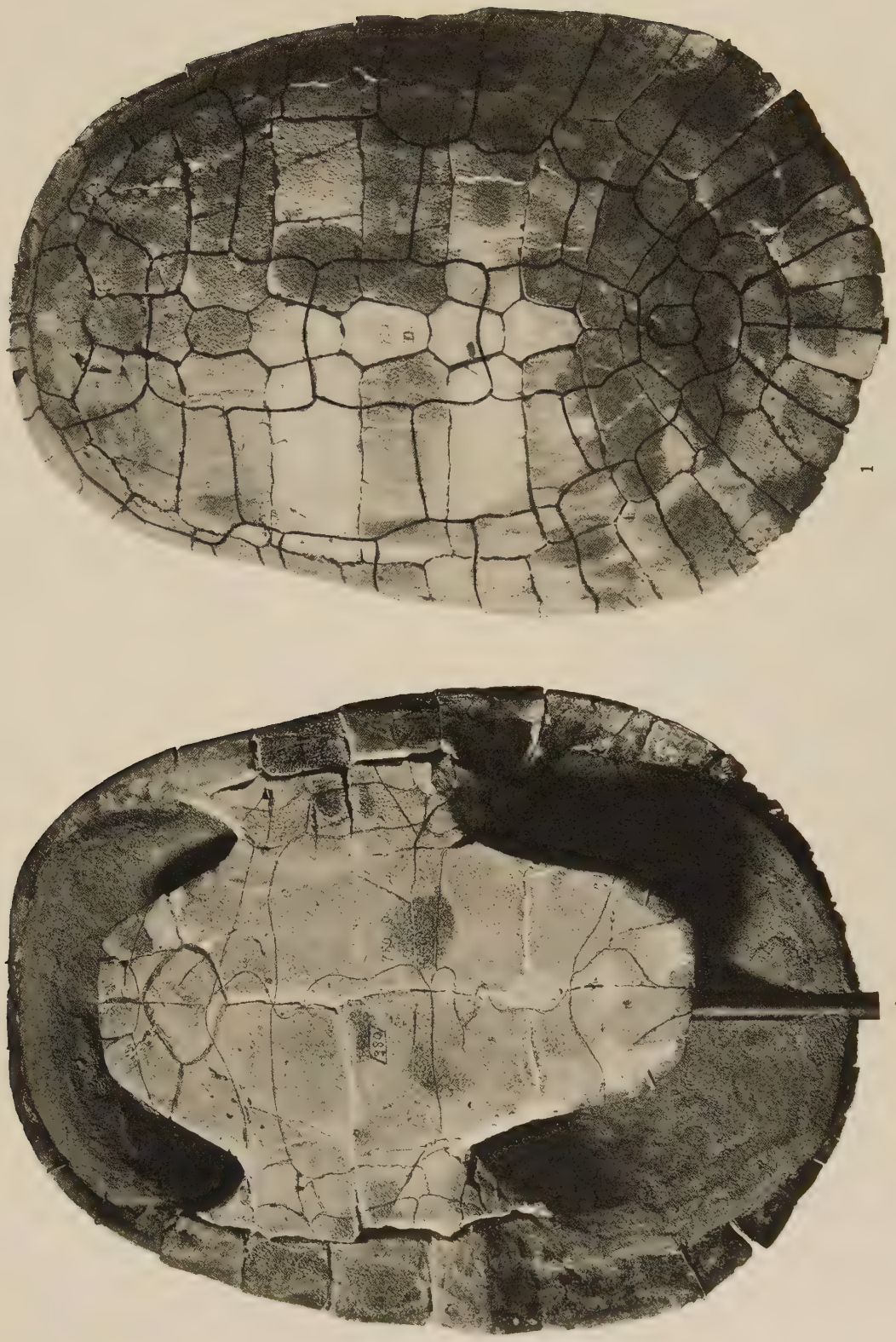


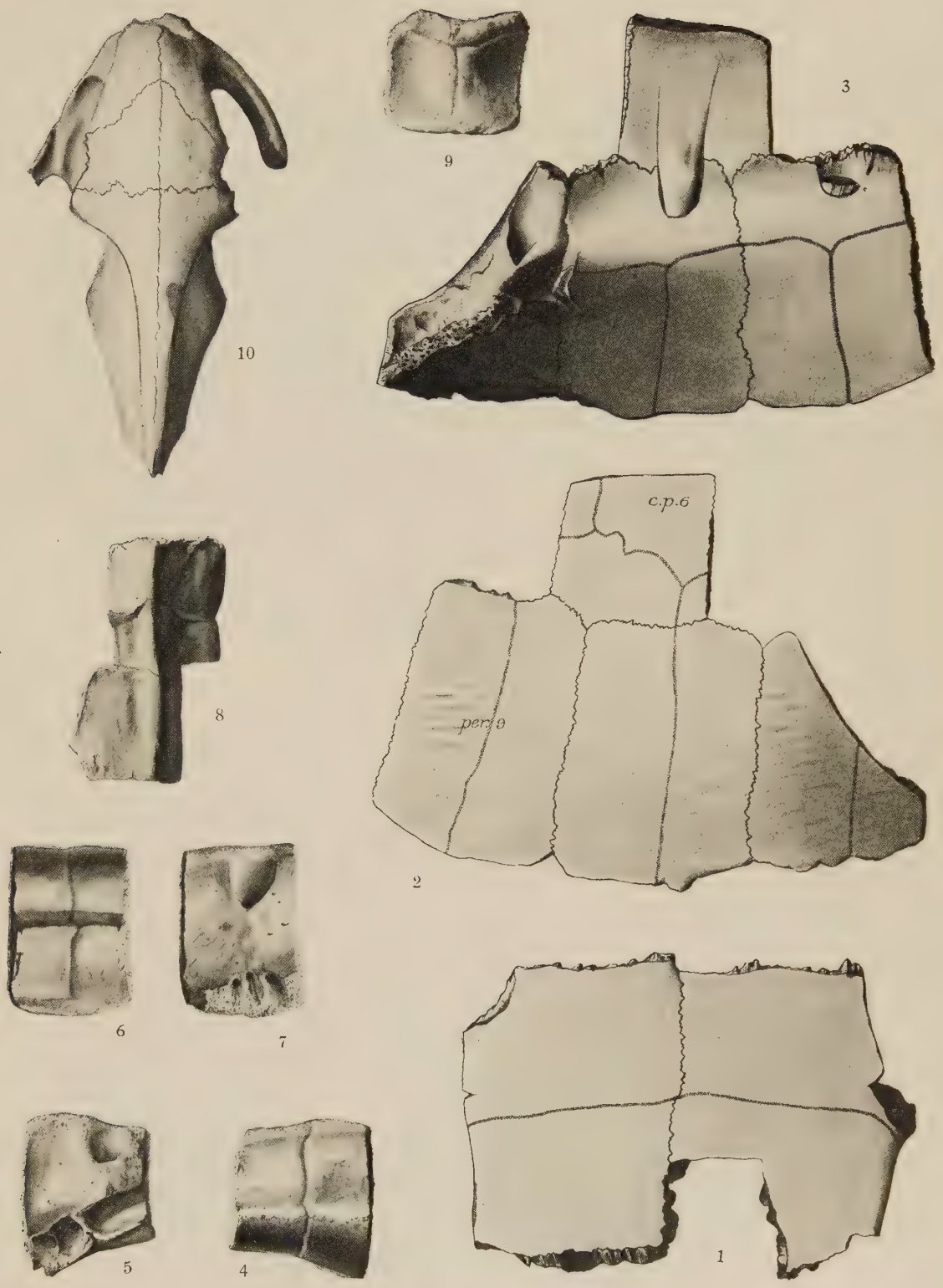
Fig. 1. Basilemys variolosa. × 1. Page 226.
Figs. 2 and 3. Compsemys victa. × 1. Page 234.
Fig. 4. Compsemys ? obscura. × 1. Page 235.
Fig. 5. Adocus punctatus. × ¼. Page 238.
Fig. 6. Adocus beatus. × ¼. Page 240.
Fig. 7. Adocus beatus. × ½. Page 240.
Fig. 8. Adocus lacer. × ¼. Page 242.



Adocus punctatus. × ¼. Page 236.

Fig. 1. Adocus lacer. × ¼. Page 241.
Fig. 2. Adocus syntheticus. × ⅓. Page 244.
Fig. 3. Adocus agilis. × ⅓. Page 246.
Fig. 4. Agomphus petrosus. × ½. Page 250.

Figs. 1 to 5. Agomphus turgidus. × ½. Page 249.
Figs. 6 and 7. Agomphus petrosus. × ½. Page 250.
Figs. 8 and 9. Agomphus pectoralis. × ½. Page 254.
Fig. 10. Zygoramma striatula. × ⅔. Page 258.
Figs. 11 to 13. Baptemys wyomingensis. × ¾. Page 273.



Figs. 1 to 3. Zygoramma striatula. × ½. Page 257. Figs. 4 to 9. Hoplochelys crassa. × 1. Page 263.
Fig. 10. Baptemys wyomingensis. × 1. Page 273.

Alamosemys substricta. × ¼. Page 260.

Fig. 1. Baptemys wyomingensis. × ⅓. Page 271.
Figs. 2 and 3. Naomichelys speciosa. × ¾. Page 101.

Baptemys wyomingensis. × 0.28. Page 272.

Baptemys fluviatilis. × 0.24. Page 277.

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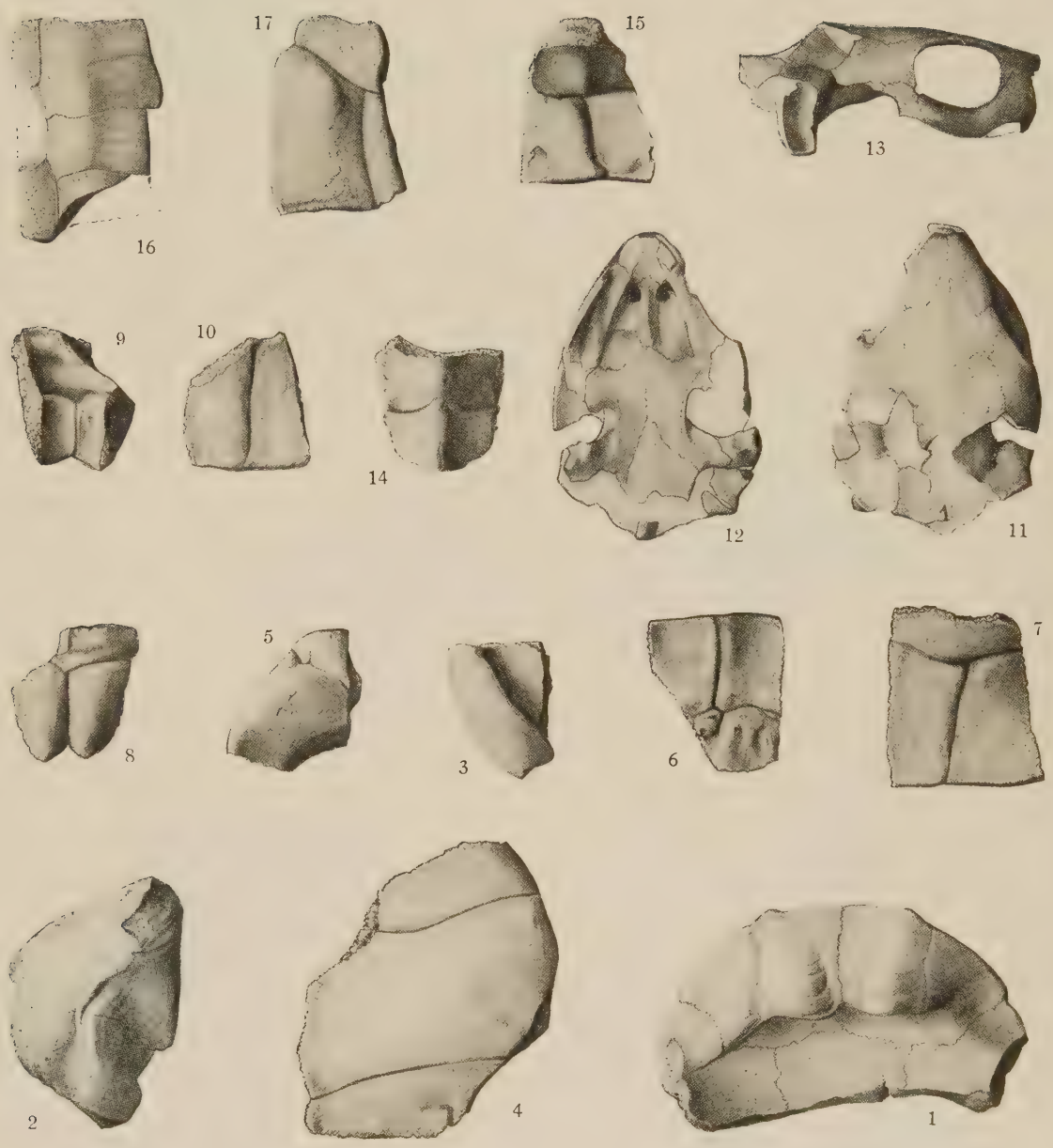
Anosteira ornata. × 1. Page 279.

2

1

Gyremys spectabilis. × ¼. Page 288.



Figs. 1 to 3. Clemmys morrisiæ. × $\frac{4}{5}$. Page 290.
Figs. 4 to 7. Clemmys hesperia. × 1. Page 292.
Figs. 8 to 10. Clemmys saxea. × 1. Page 294.
Figs. 11 to 13. Echmatemys sp. indet. × 1. Page 297.
Figs. 14 and 15. Echmatemys megaulax. × 1. Page 302.
Figs. 16 and 17. Echmatemys testudinea. × $\frac{4}{5}$. Page 303.

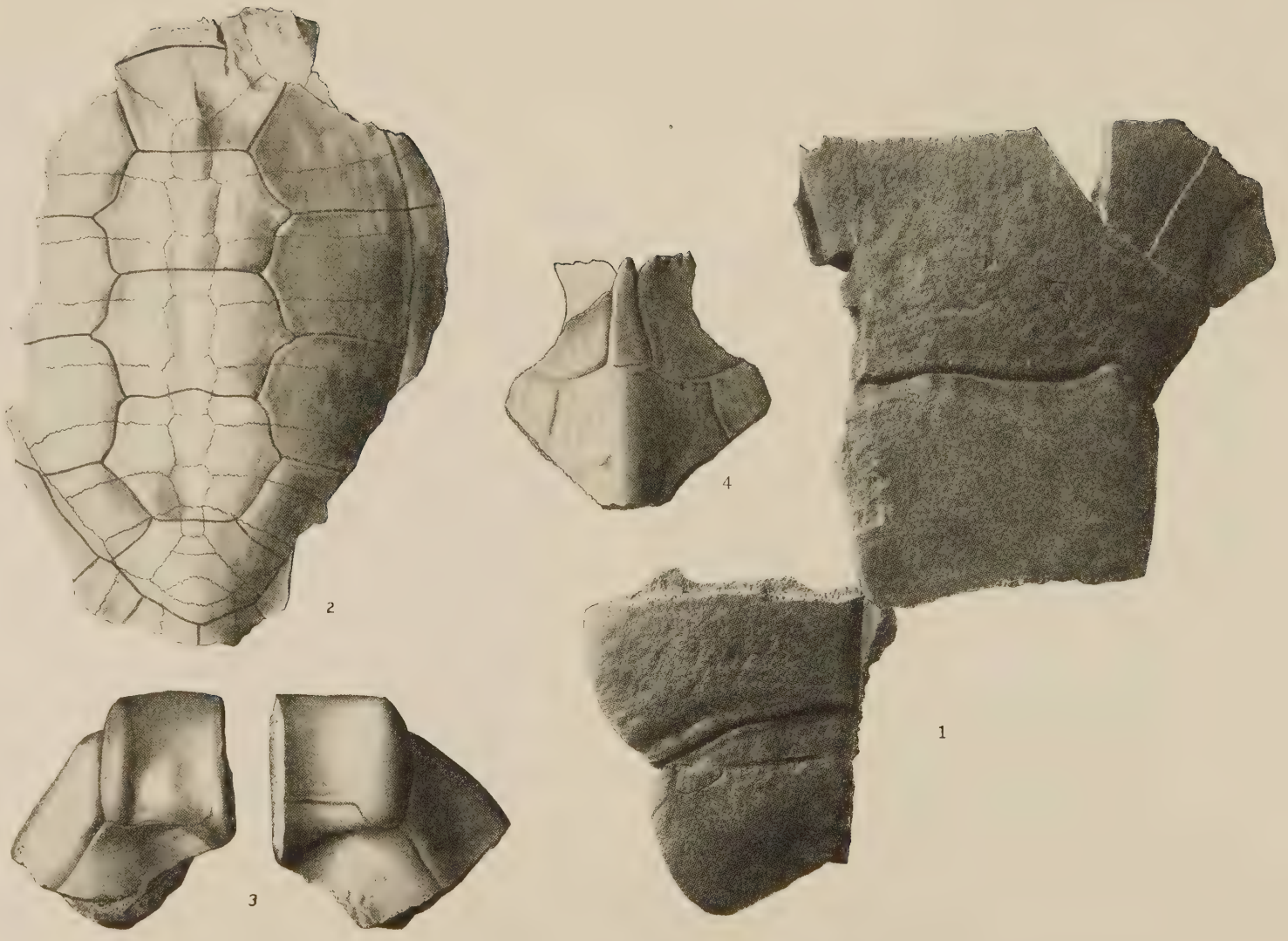
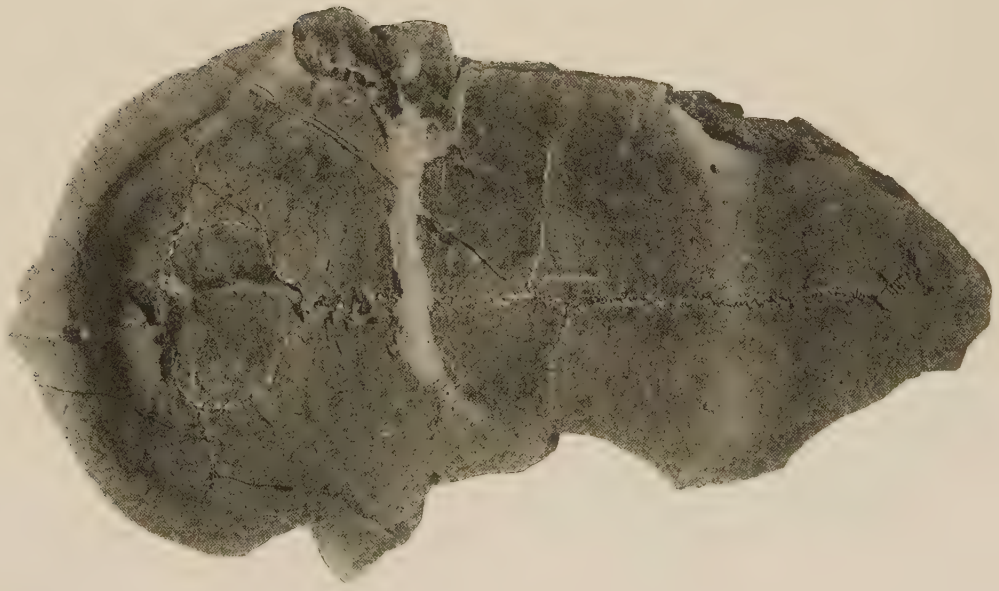


Fig. 1. Echmatemys euthneta. × 0.96. Page 306. Fig. 2. Chrysemys timida. × 0.62. Page 345.
Figs. 3 and 4. Trachemys petrolei. × 0.8. Page 353.

Fig. 1. Echmatemys wyomingensis. × ⅓. Page 310.
Fig. 2. Echmatemys haydeni. × ⅓. Page 314.

Echmatemys stevensoniana. × ¼. Page 317.

1



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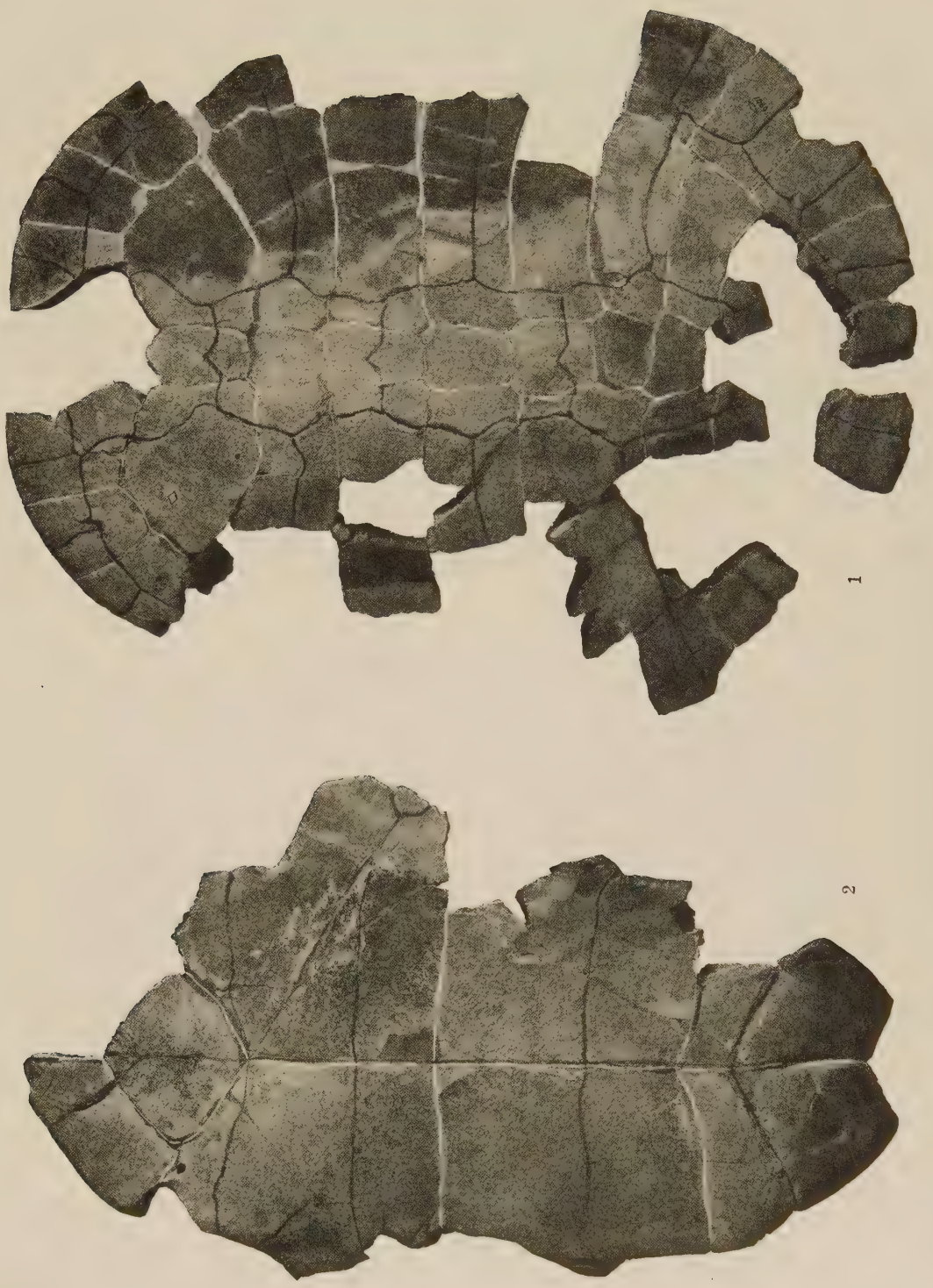
Echmatemys arethusa. × ½. Page 323.

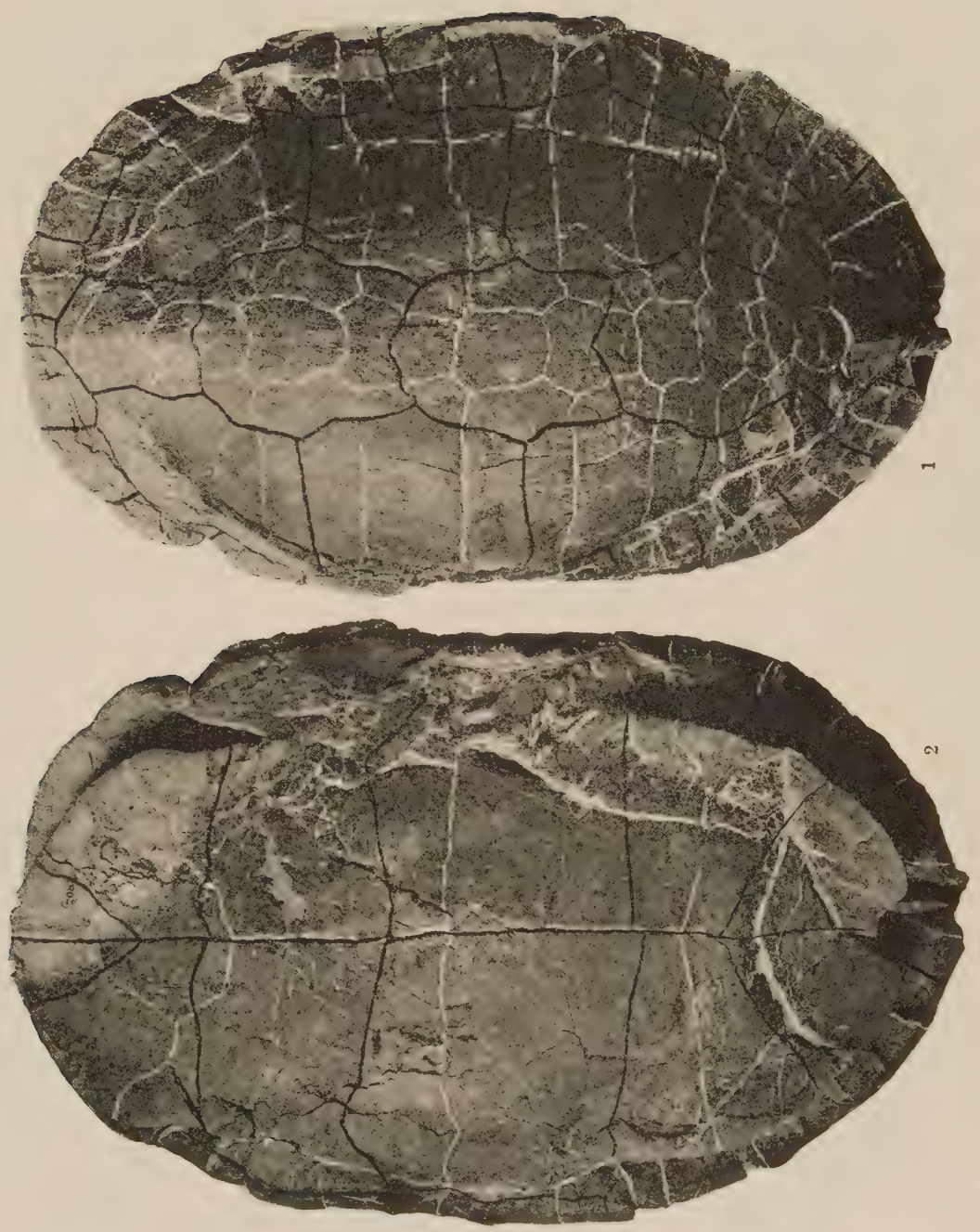


Echmatemys shaughnessiana. × ⅜. Page 327.

1

2

Echmatemys naomi. × ½. Page 335.



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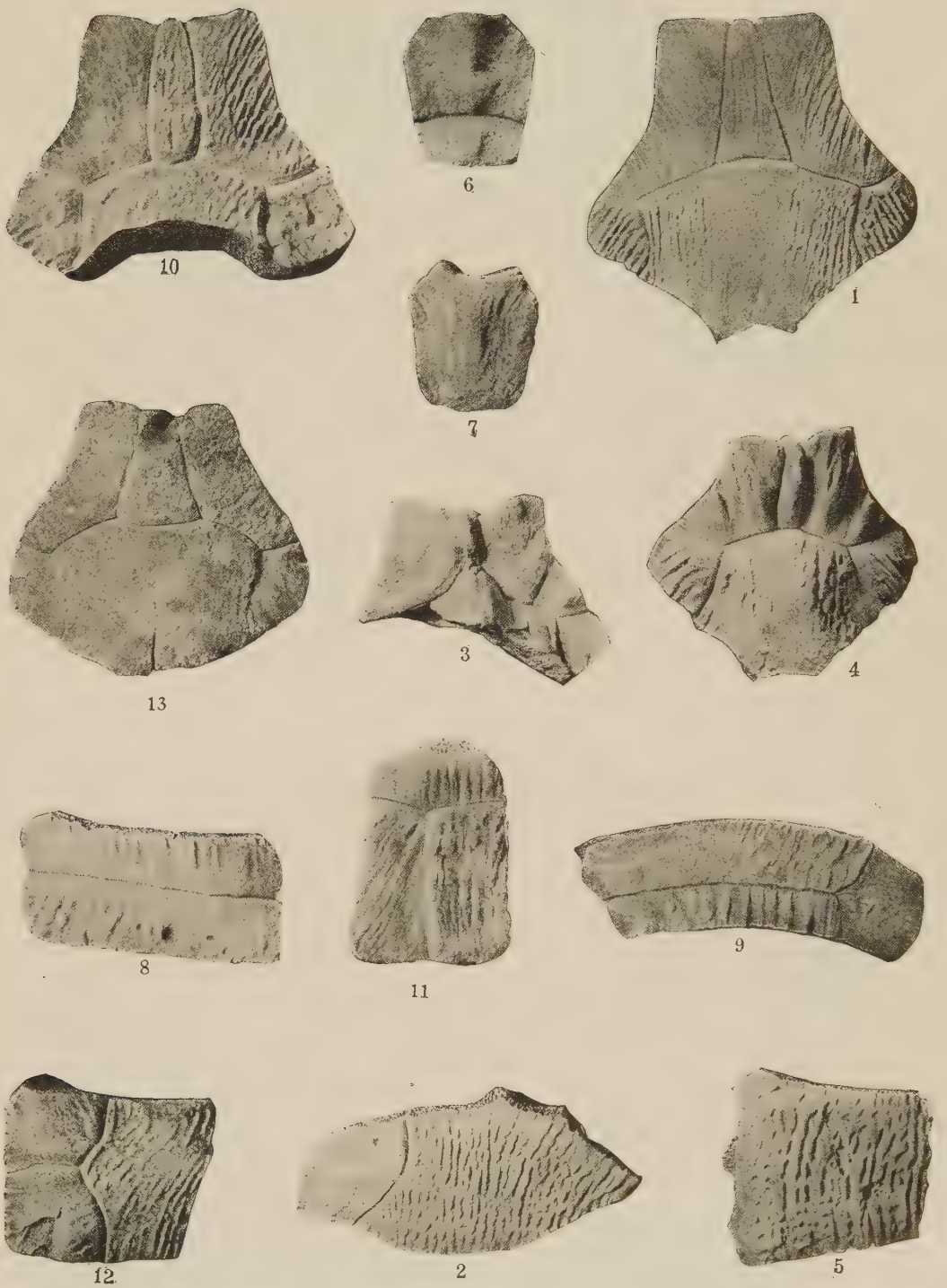
2

Echmatemys callopyge. × 0.3. Page 340.

Echmatemys unintensis. × 0.3. Page 342.



Figs. 1 and 2. Deirochelys floridana. × $\frac{4}{5}$. Page 346. Figs. 4 to 9. Trachemys sculpta. × $\frac{4}{5}$. Page 351.
Fig. 3. Trachemys euglypha ? × $\frac{4}{5}$. Page 351. Figs. 10 to 12. Trachemys jarmani. × $\frac{4}{5}$. Page 351.
Fig. 13. Pseudemys extincta. × $\frac{4}{5}$. Page 356.

Trachemys hilli. × 0.7. Page 348.

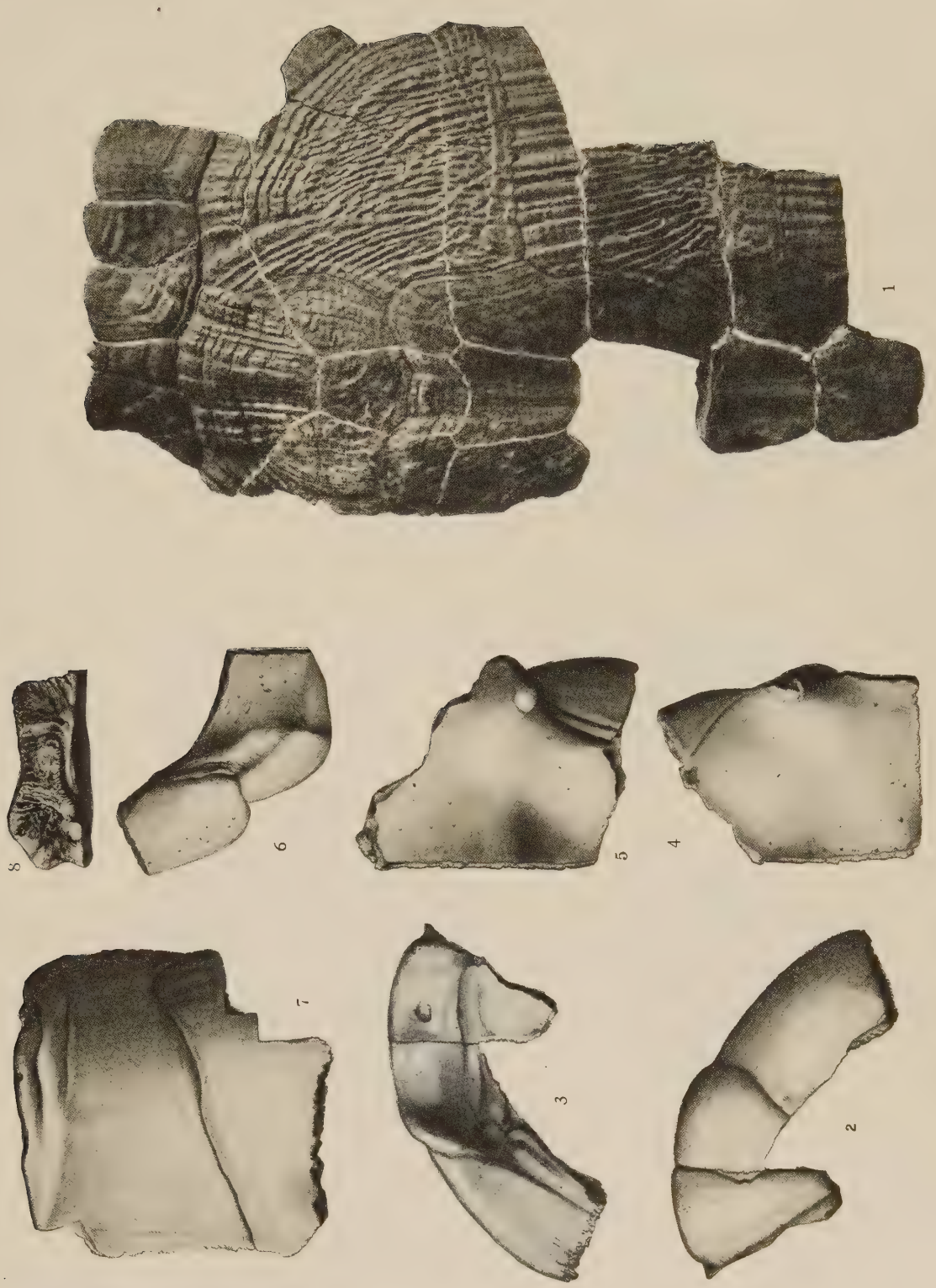
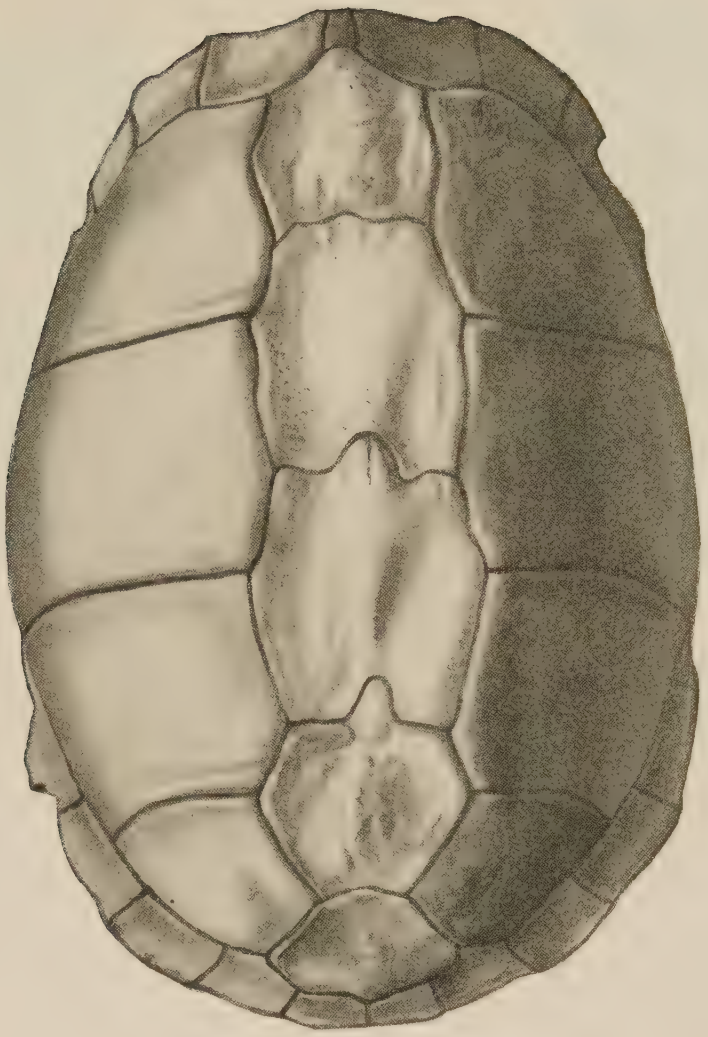


Fig. 1. Trachemys bisornata. × ¾. Page 354. Figs. 2 to 6. Trachemys trulla. × ¾. Page 355.
Figs. 7 to 8. Terrapene putnami. × ¾. Page 360.

Pseudemys cælata. × 1. Page 356.



1

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Terrapene marnochi. × $\frac{5}{8}$. Page 362.

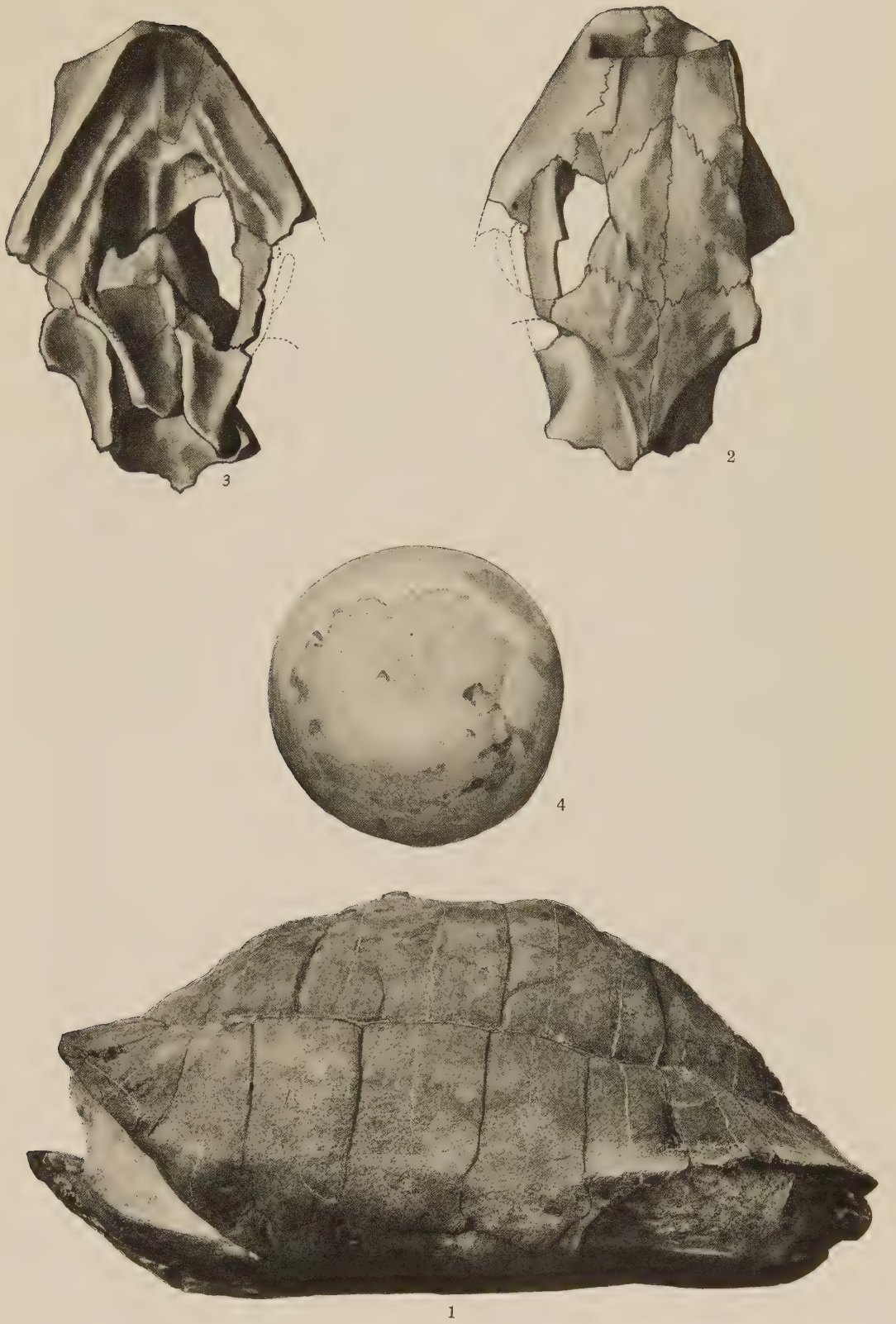
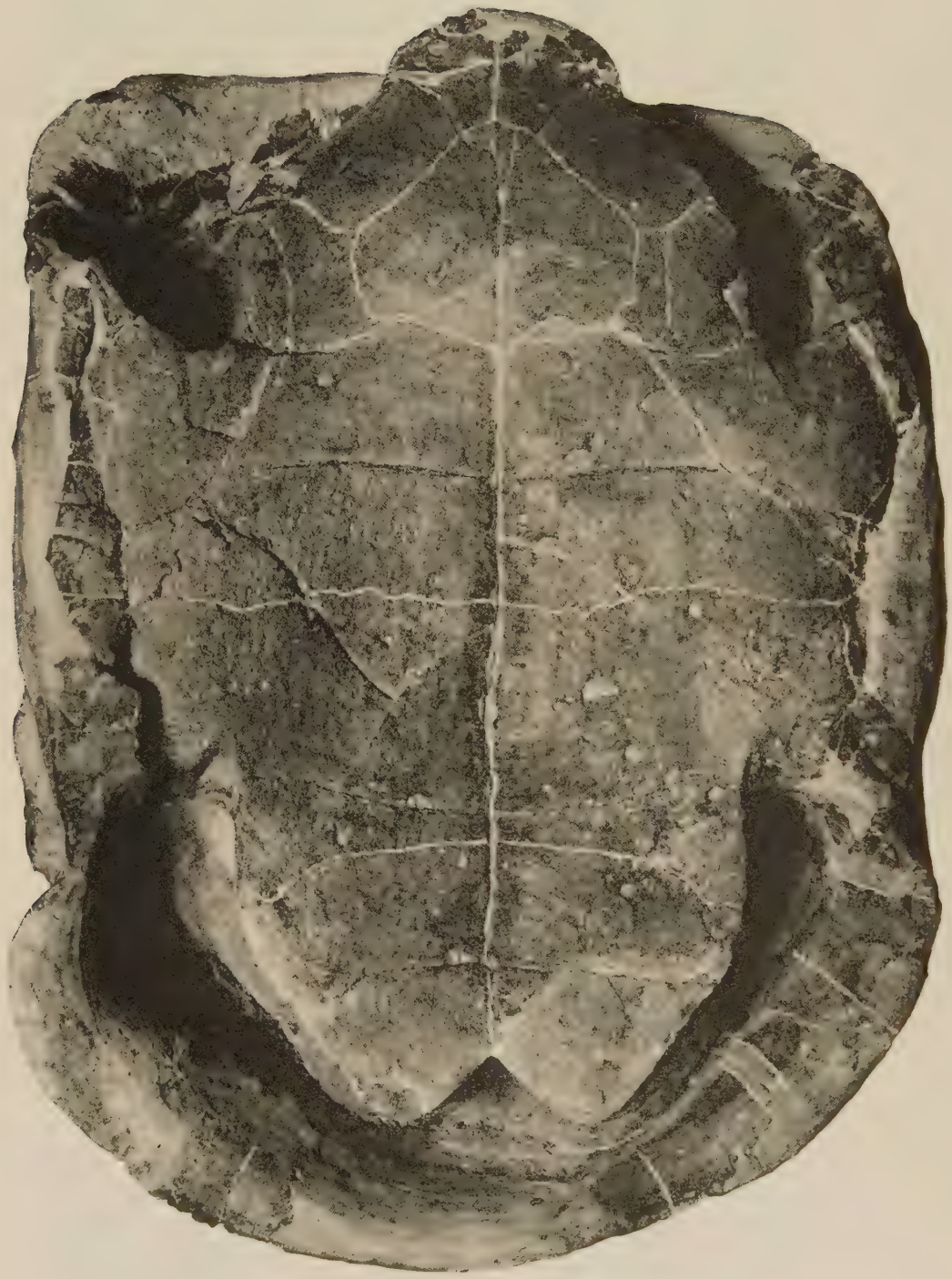


Fig. 1. Hadrianus majusculus. × ¼. Page 374.
Figs. 2 to 4. Stylemys nebrascensis. × 1. Page 388.

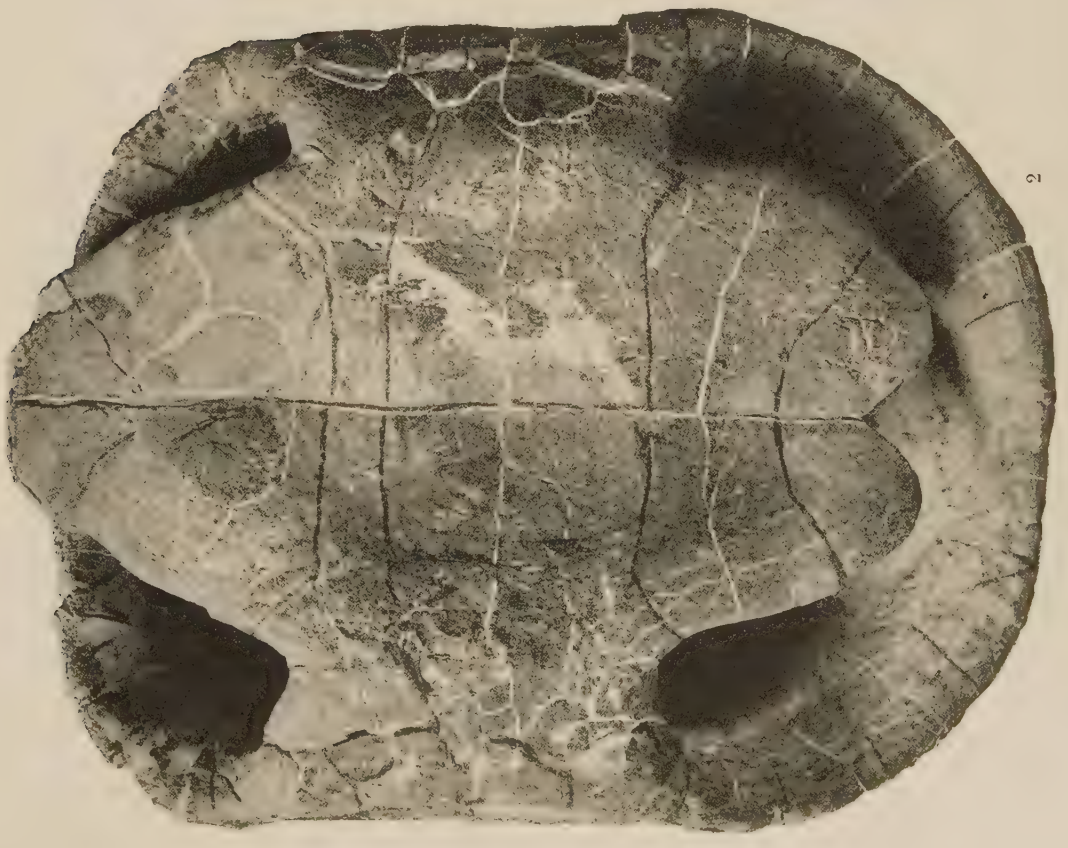
Hadrianus corsoni. × $\frac{3}{8}$. Page 377.



Hadrianus corsoni. × $\frac{3}{8}$. Page 378.

Stylemys nebrascensis. × ½. Page 388.

1



2

Stylemys capax. × 0.28. Page 392.

1

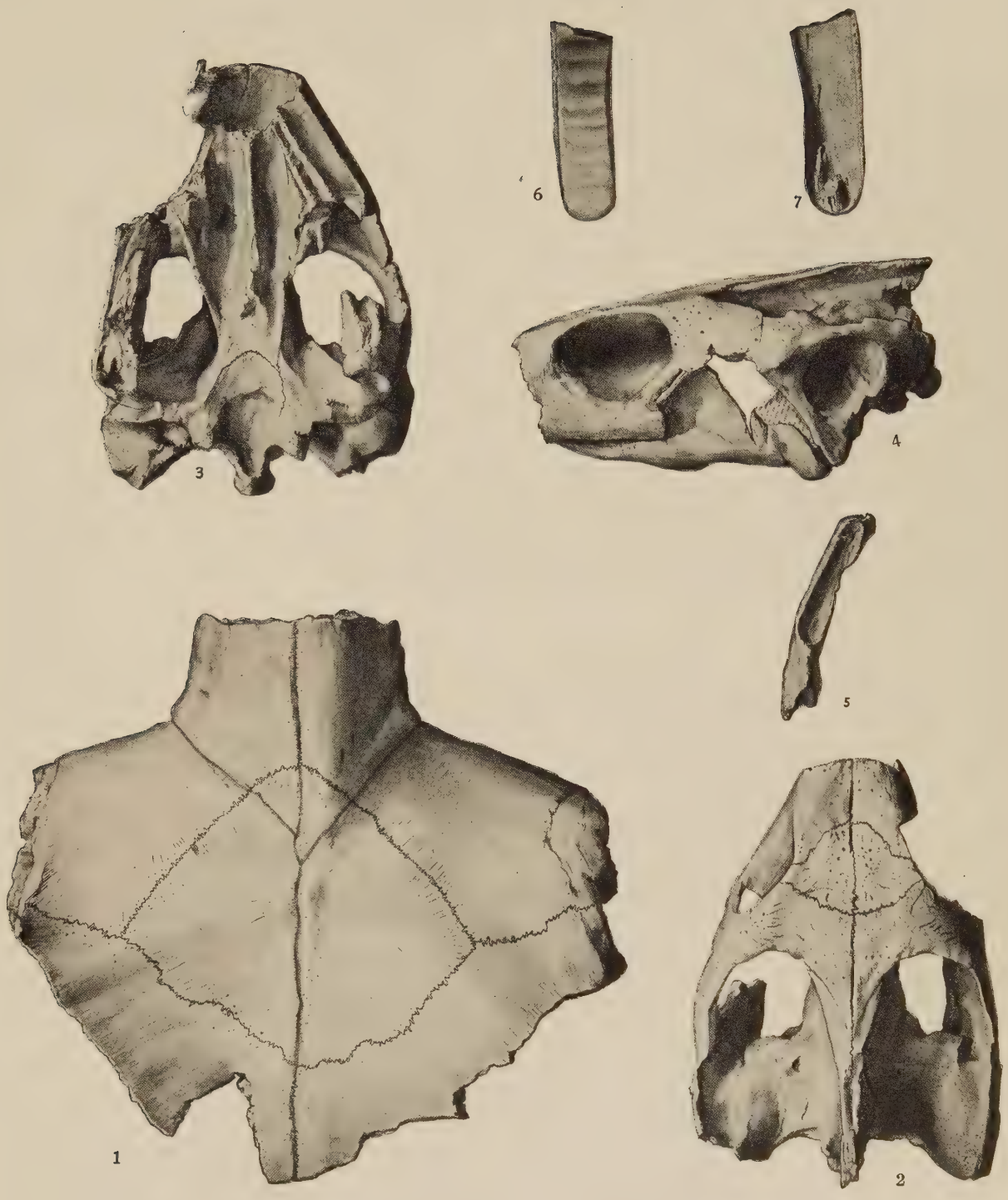
2

Stylemys conspecta. × 0.45. Page 393.

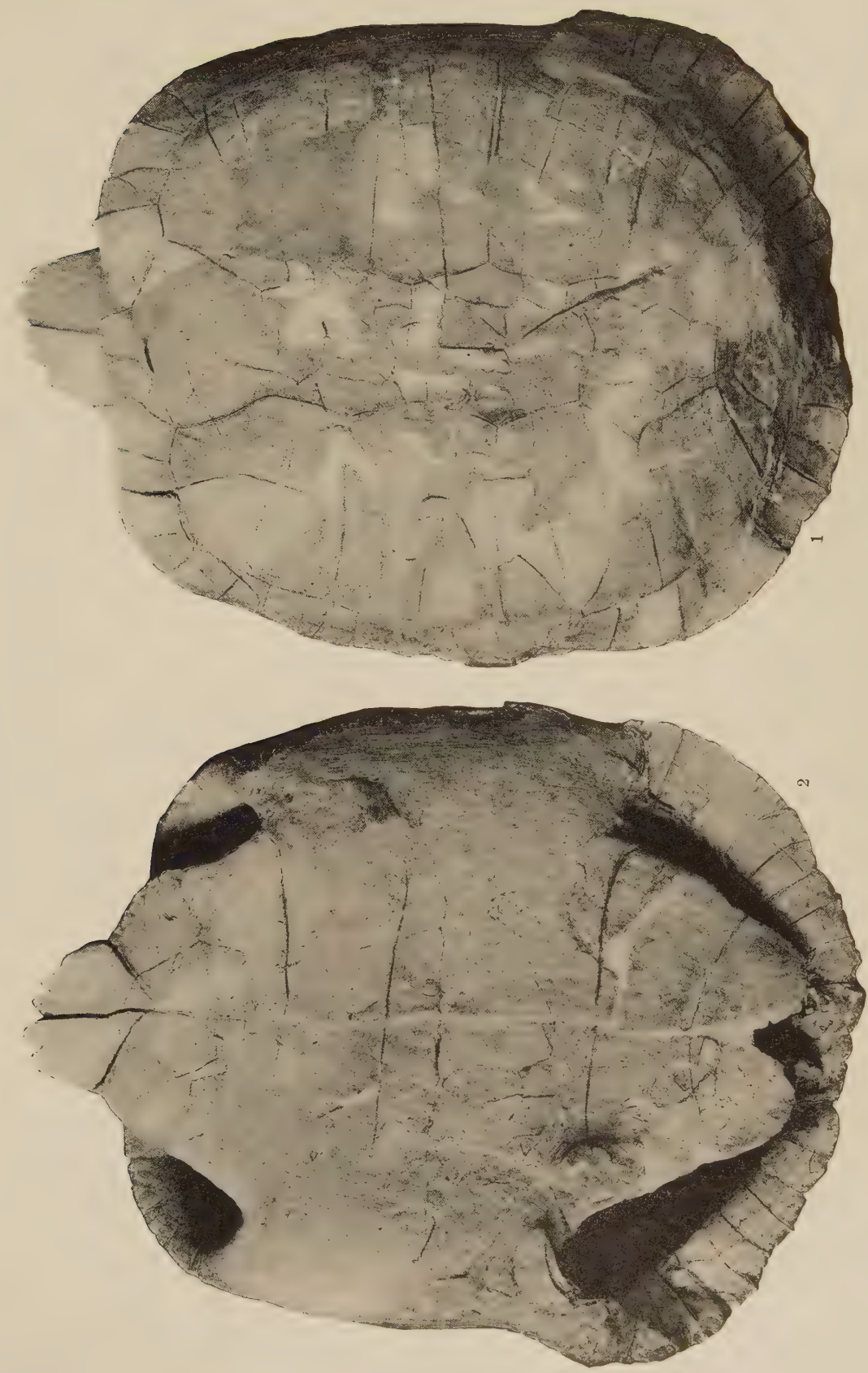
1

2

Testudo brontops. × 0.15. Page 398.



Figs. 1 to 5. Testudo thomsoni. Fig. 1, × ½; Figs. 2 to 5, × ⅓. Page 400.
Figs. 6 and 7. Testudo exornata. × ⅓. Page 401.



Testudo laticunea. × 0.28. Page 402.

1

2

Testudo inusitata. × ½. Page 417.

2

1

Testudo farri. × $\frac{3}{8}$. Page 418.

Testudo emiliæ. × ⅓. Page 419.

1

2

Testudo pansa. × $\frac{1}{7}$. Page 420.

Testudo osborniana. × ⅓. Page 423.

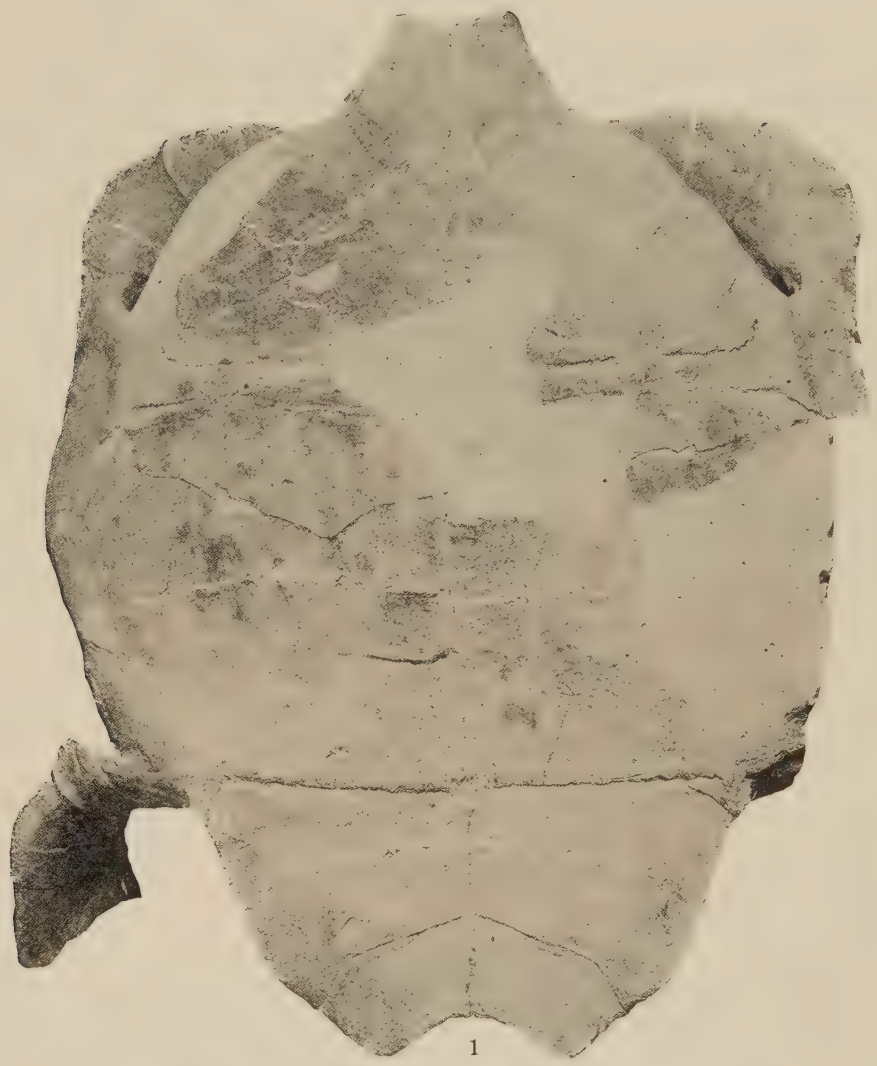
Testudo osborniana. × ⅓. Page 424.

Testudo osborniana. × ⅓. Page 427.

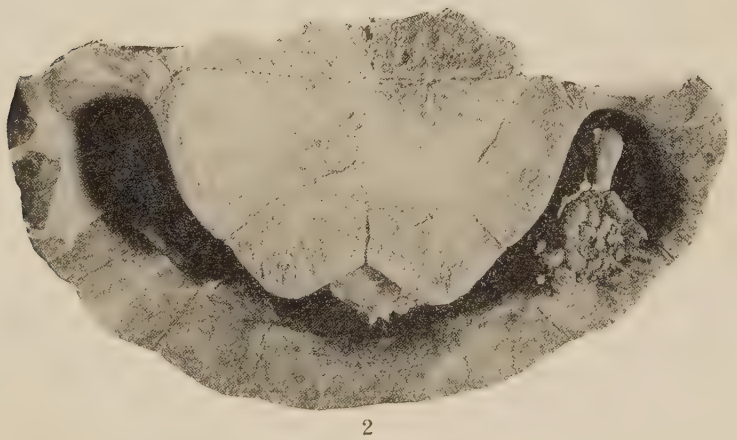
Testudo osborniana. × ½. Page 429.

Testudo impensa. × $\frac{1}{6}$. Page 433.

Testudo impensa. × ⅛. Page 433.



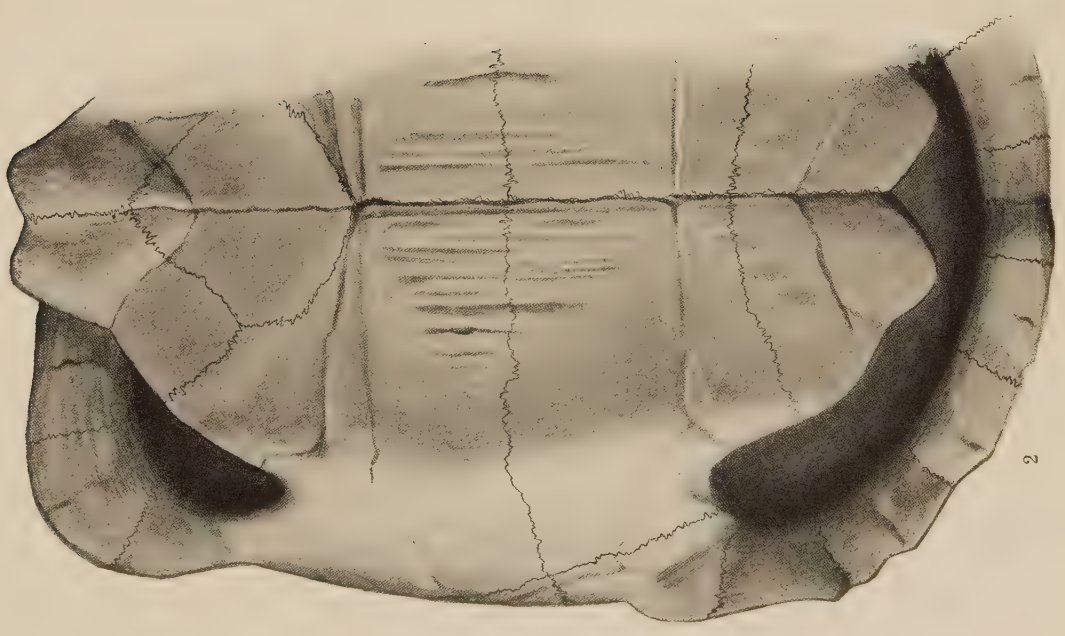
1



2

Testudo orthopygia. Fig. 1, $\times \frac{1}{4}$; Fig. 2, $\times \frac{1}{6}$. Page 440.

1



2

Testudo orthopygia. × ½. Page 448.

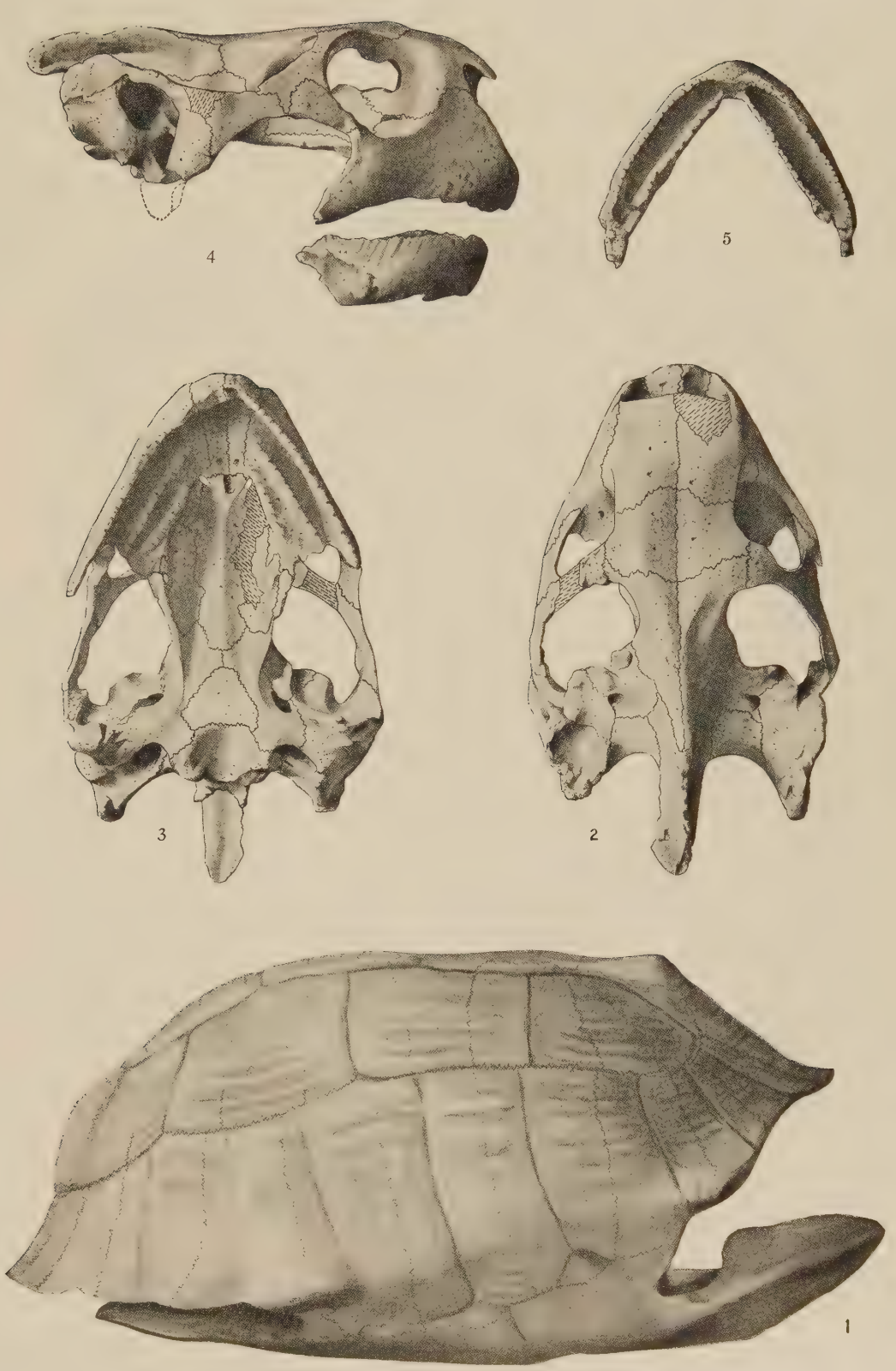
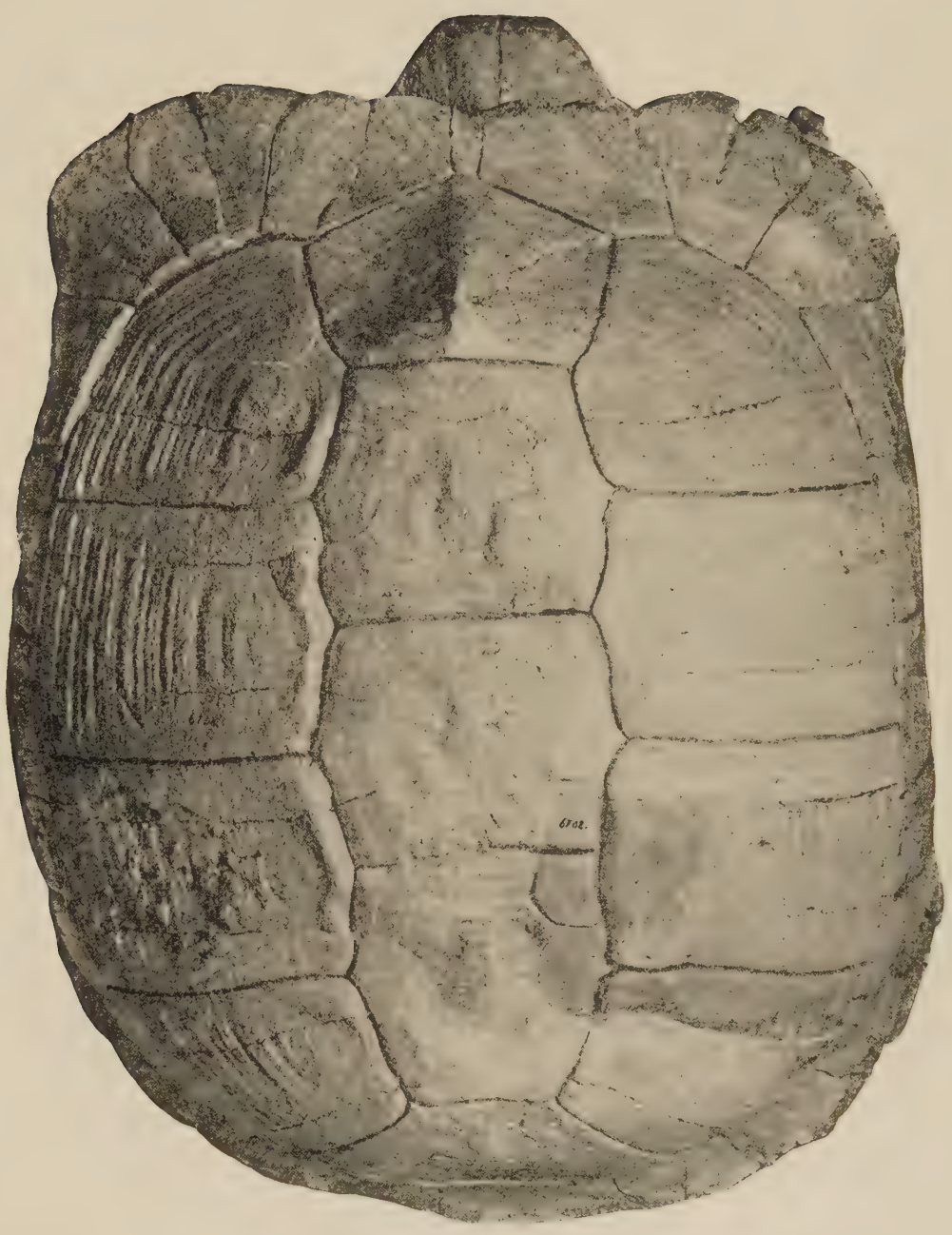
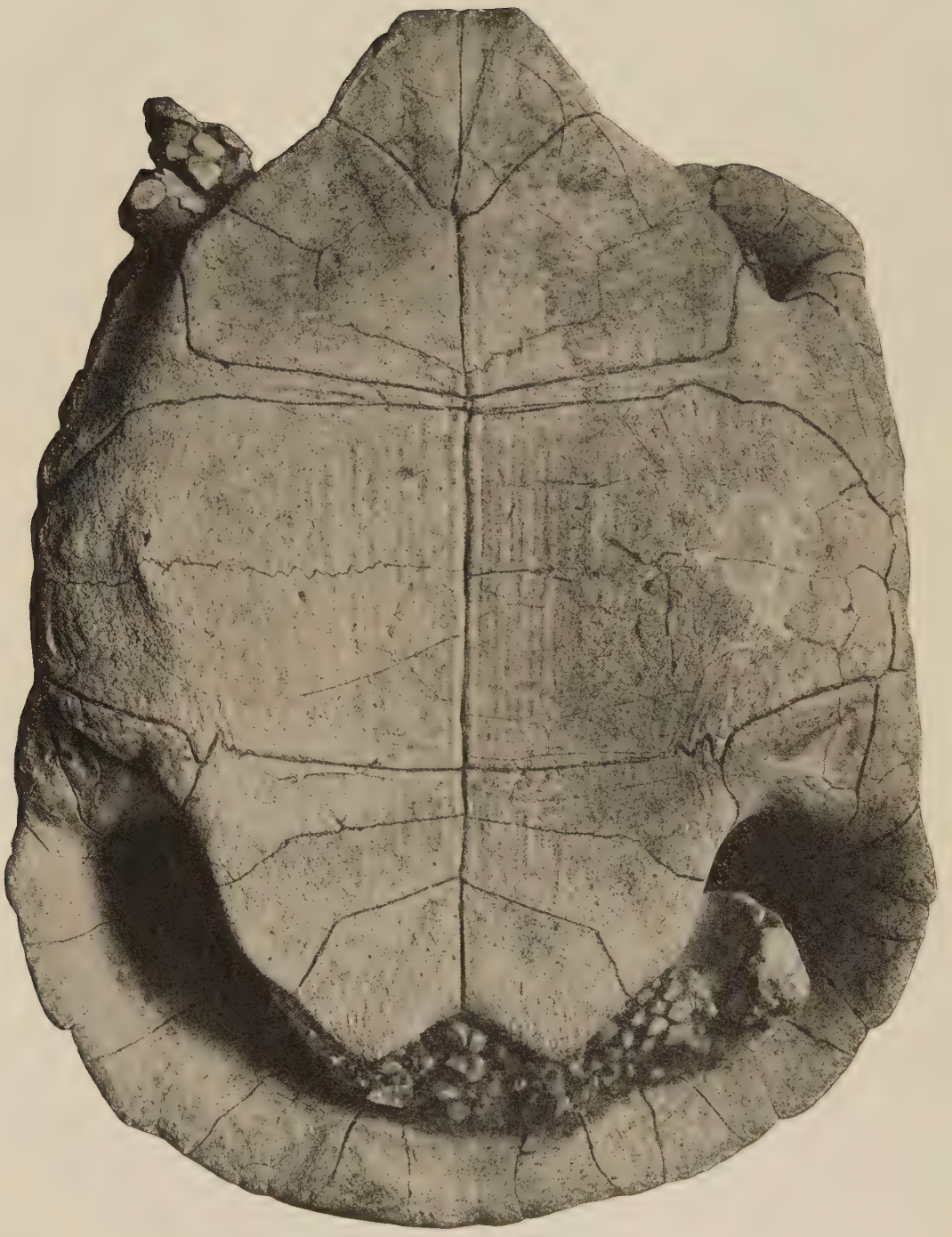


Fig. 1. Testudo orthopygia. × ⅛. Page 448.
Figs. 2 to 5. Testudo gilberti. × ¾. Page 449.



Testudo orthopygia. × ¼. Page 448.



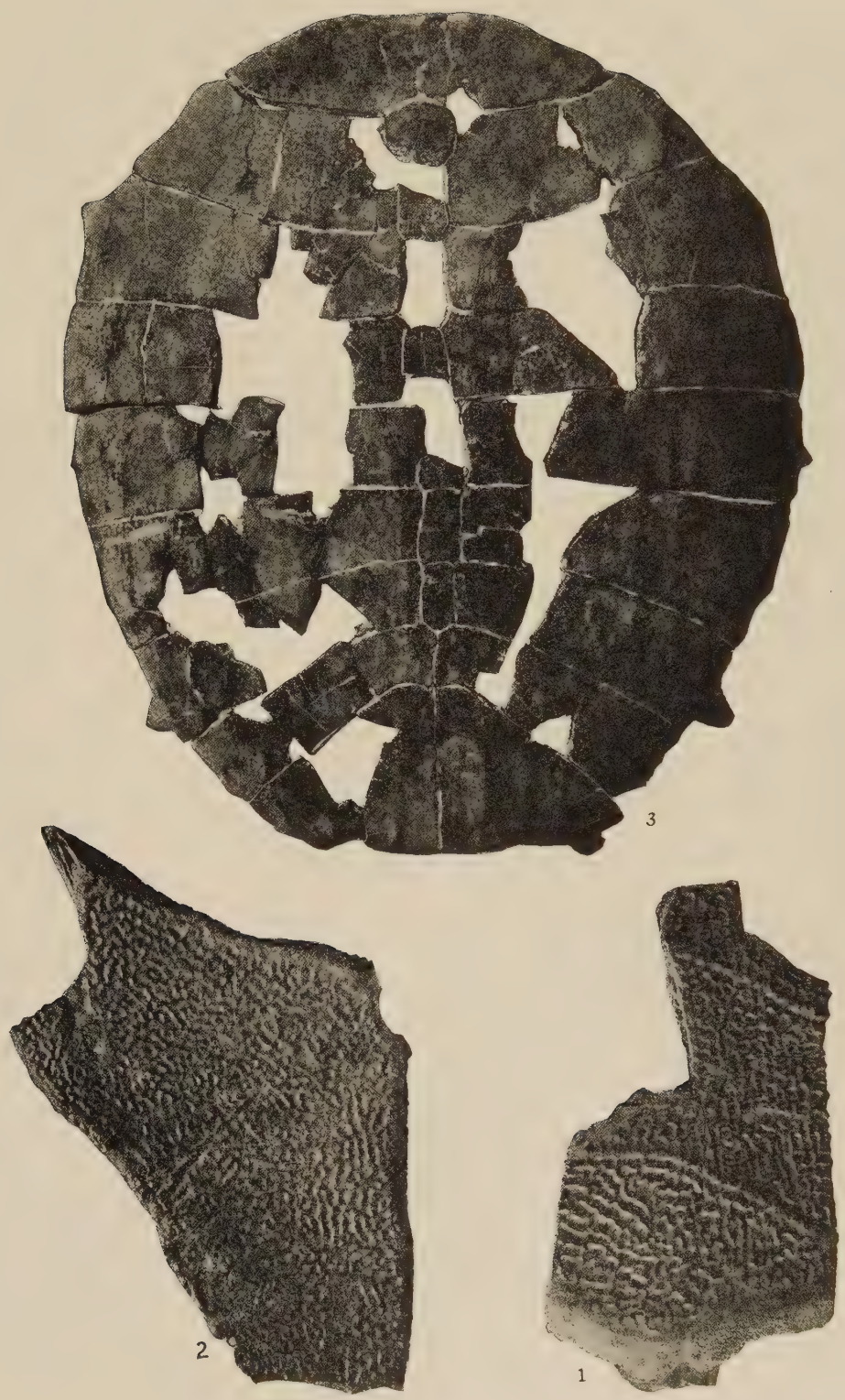
Testudo orthopygia. × ¼. Page 448.

1

2

Testudo edæ. × 0.3. Page 450.

Testudo hollandi. × ¼. Page 451.



Figs. 1 and 2. Plastomenus costatus. × 1. Page 468.
Fig. 3. Plastomenus molopinus. × ⅜. Page 482.

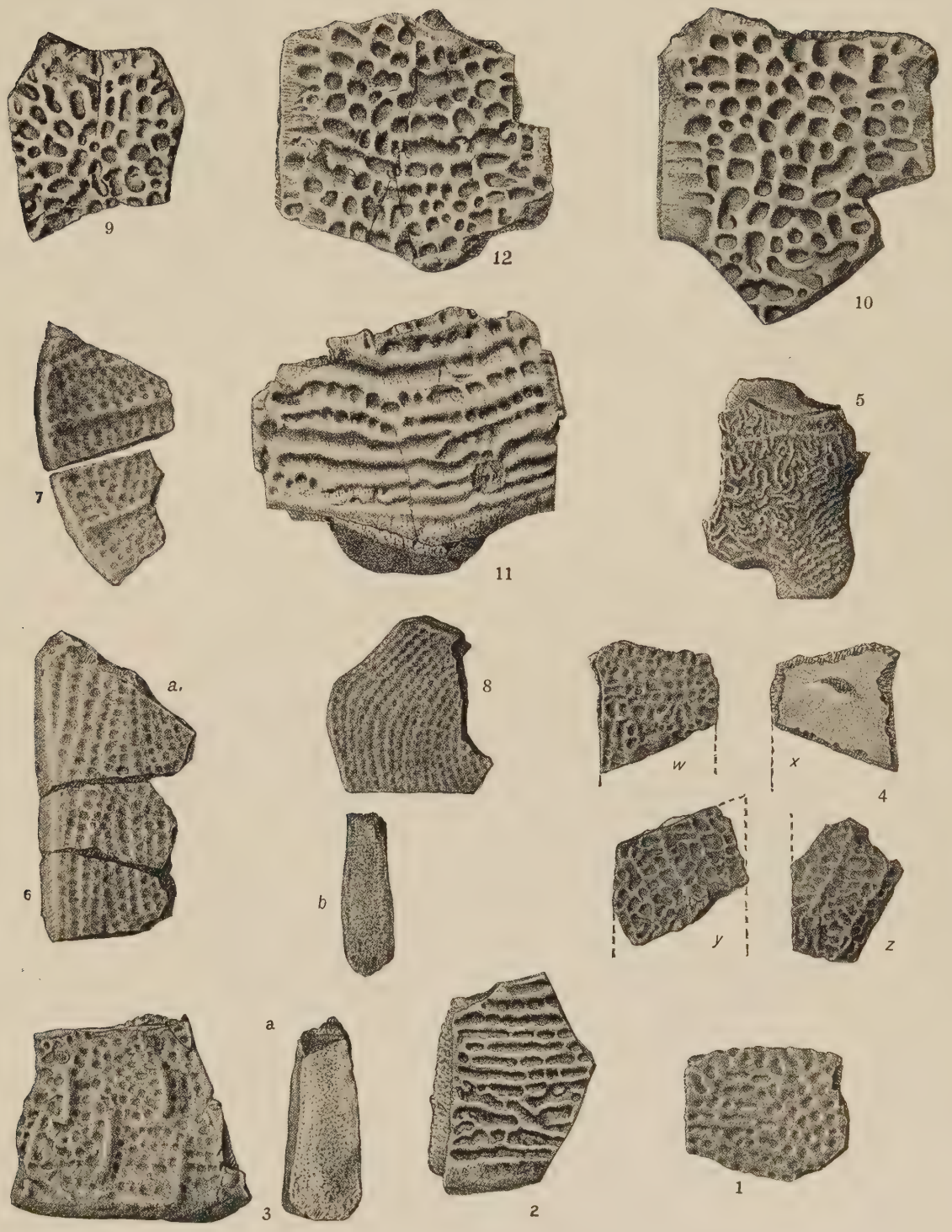
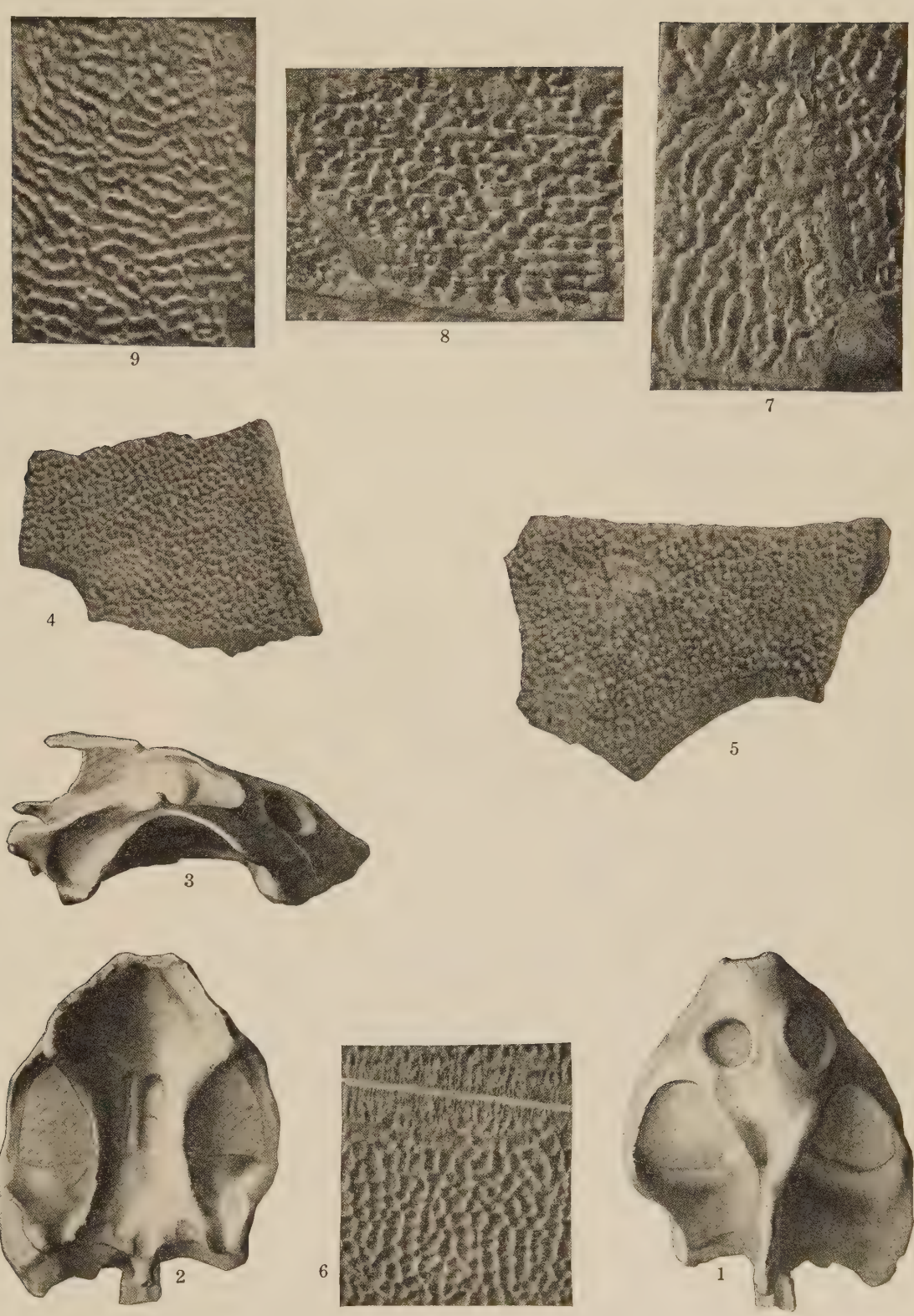


Fig. 1. Plastomenus catenatus. × 1. Page 470.
Fig. 2. Plastomenus? leptomitus. × 1. Page 471.
Figs. 3 and 3a. Plastomenus? lachrymalis. × 1. Page 472.
Fig. 4. Plastomenus? fractus. × 1. Page 472.
Fig. 5. Plastomenus corrugatus. × 1. Page 473.
Figs. 6a and 6b to 8. Plastomenus communis. × 1. Page 473.
Figs. 9 and 10. Amyda? cariosa. × 1. Page 516.
Figs. 11 and 12. Amyda radula. × 1. Page 517.

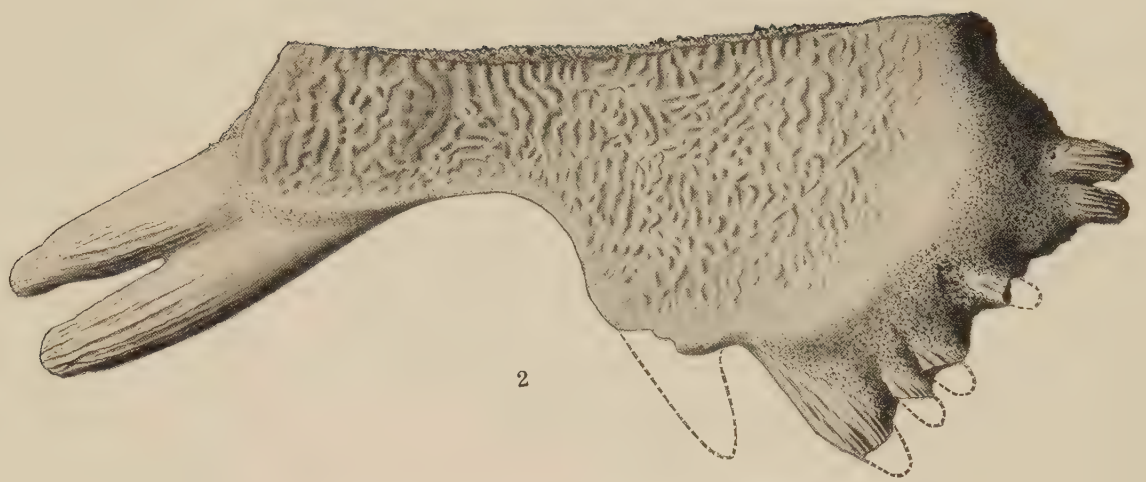
2

1

Plastomenus visendus. × ½. Page 477.



Figs. 1 to 3. Conchochelys admirabilis. × ½. Page 483. Fig. 6. Aspideretes coalescens. × 1. Page 490.
Figs. 4 and 5. Helopanoplia distincta. × 1. Page 485. Figs. 7 to 9. Aspideretes splendidus. × 1. Page 491.



2

1

Aspideretes foveatus. Fig. 1, × ½; Fig. 2, × 1. Page 487.

2

1

Fig. 1. Aspideretes coalescens. × ¼. Page 490.
Fig. 2. Aspideretes beecheri. × ¼. Page 493.

Aspideretes splendidus. × 0.28. Page 490.

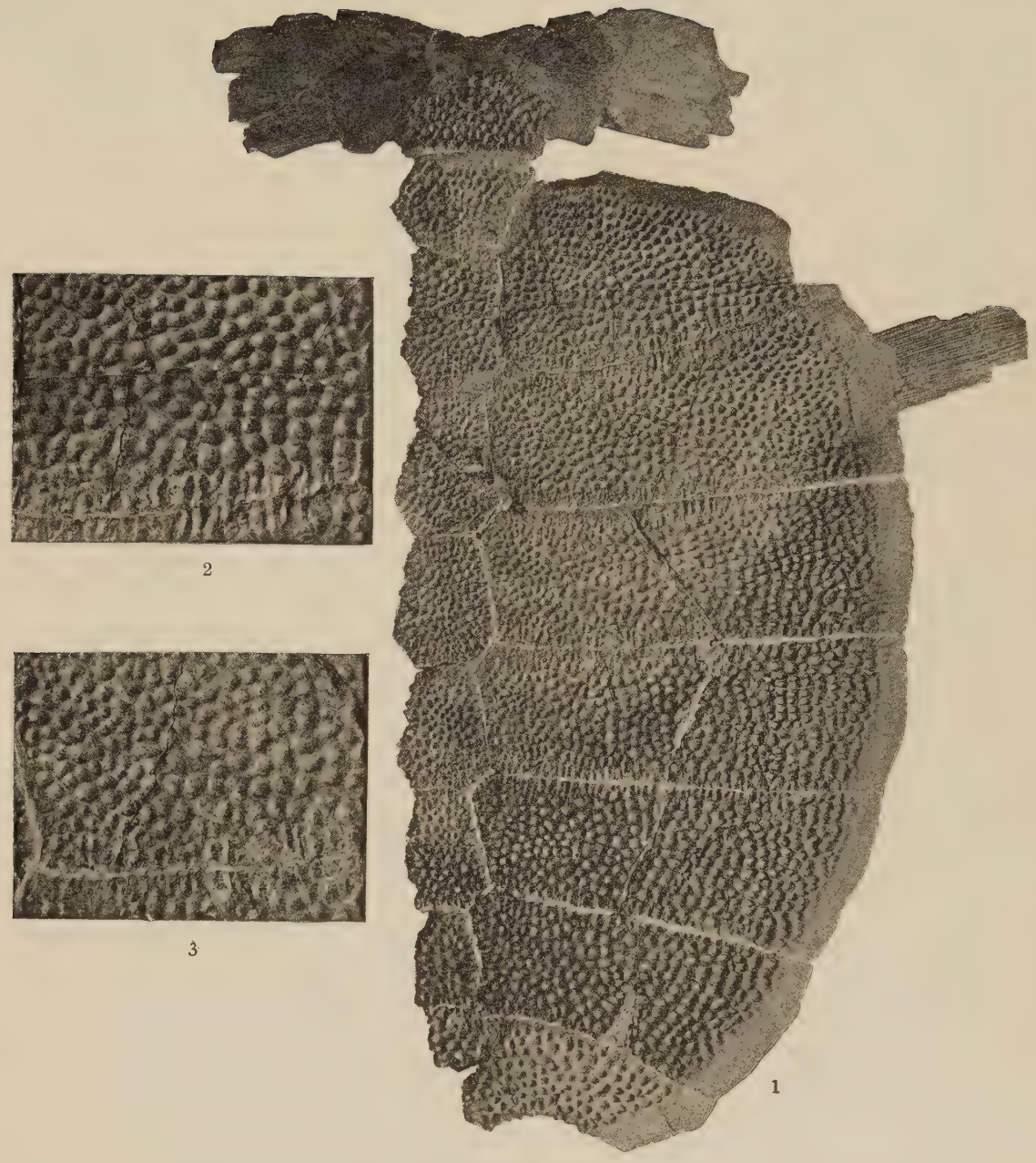
Aspideretes beecheri. × ¼. Page 492.

2

3

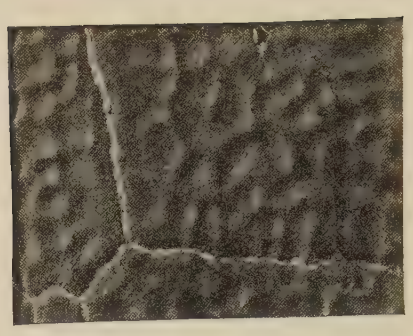
1

Aspideretes foveatus. Fig. 1, × ⅓; Figs. 2 and 3, × 1. Page 497.



Aspideretes puercensis. Fig. 1, × ½; Figs. 2 and 3, × 1. Page 499.

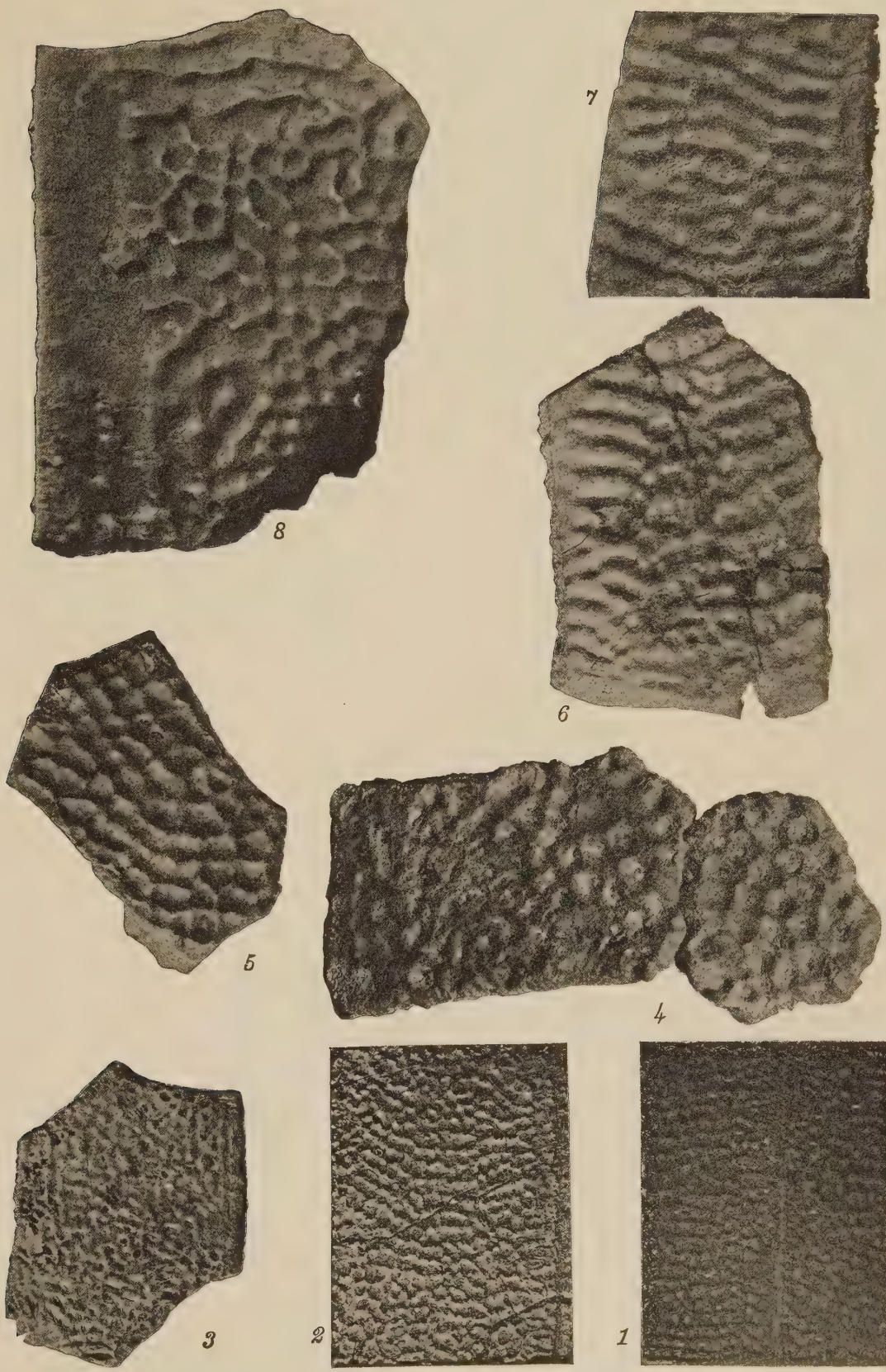
3



2

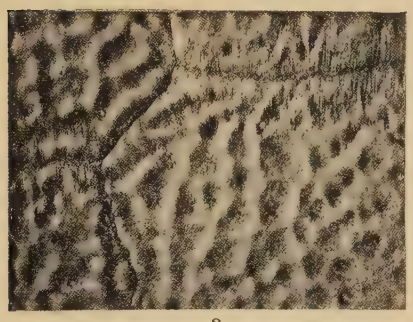
1

Aspideretes ellipticus. Fig. 1, × ⅔; Figs. 2 and 3, × 1. Page 505.

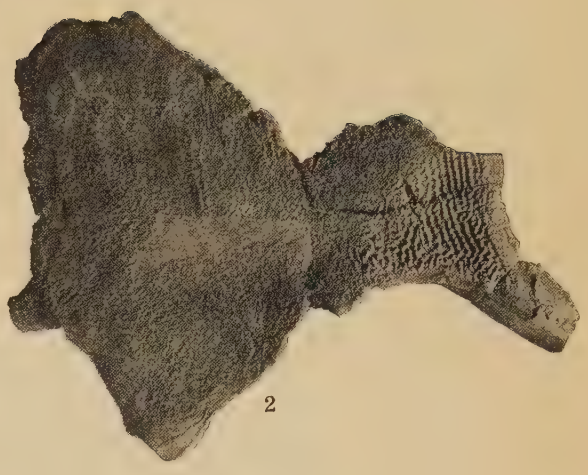


Figs. 1 and 2. Aspideretes beecheri. × 1. Page 492.
Fig. 3. Aspideretes vagans. × 1. Page 497.
Figs. 4 and 5. Amyda? halophila. × 1. Page 513.
Fig. 6. Amyda? pennata. × 1. Page 514.
Figs. 7 and 8. Amyda? virginiana. × 1. Page 515.

4



3



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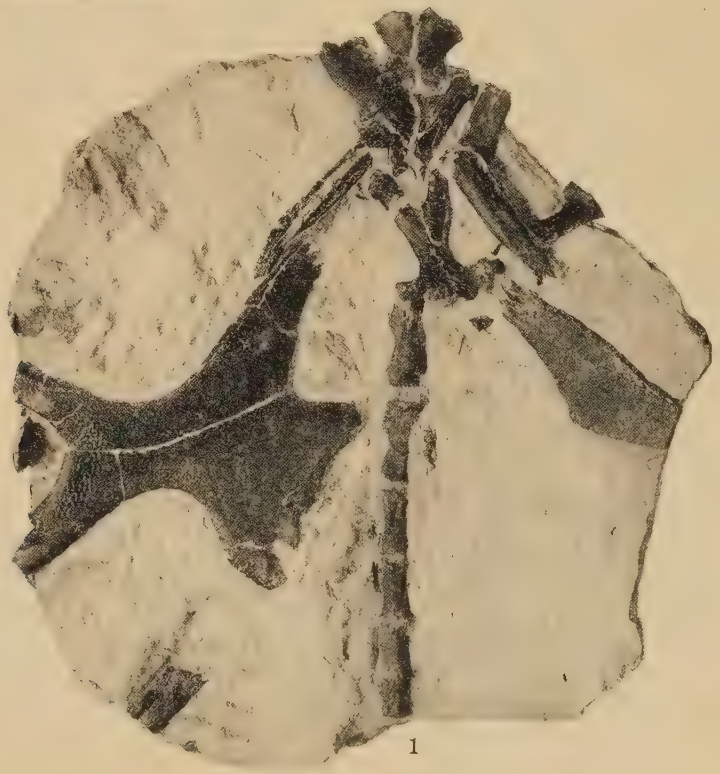
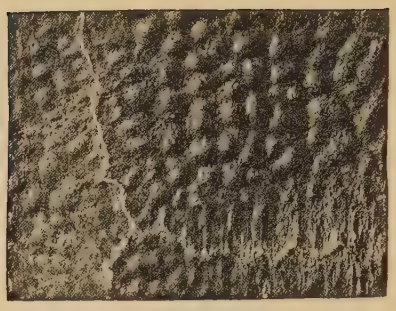


1

Fig. 1. Amyda uintensis. × 0.27. Page 521.

Figs. 2 to 4. Amyda scutumantiquum. Fig. 2, × ⅓; Figs. 3 and 4, × 1. Page 521.

3



2

1

Amyda æqua. Fig. 1, × 0.3; Figs. 2 and 3, × 1. Page 518.

Figs. 1 to 6. Amyda ventricosa. × 1. Page 516.
Figs. 7 to 10. Amyda concentrica. × 1. Page 523.
Fig. 11. Amyda lima. × 1. Page 533.
Fig. 12. Amyda buiei. × 1. Page 534.
Fig. 13. Platypeltis serialis. × 1. Page 538.
Fig. 14. Platypeltis heteroglypta. × 1. Page 544.

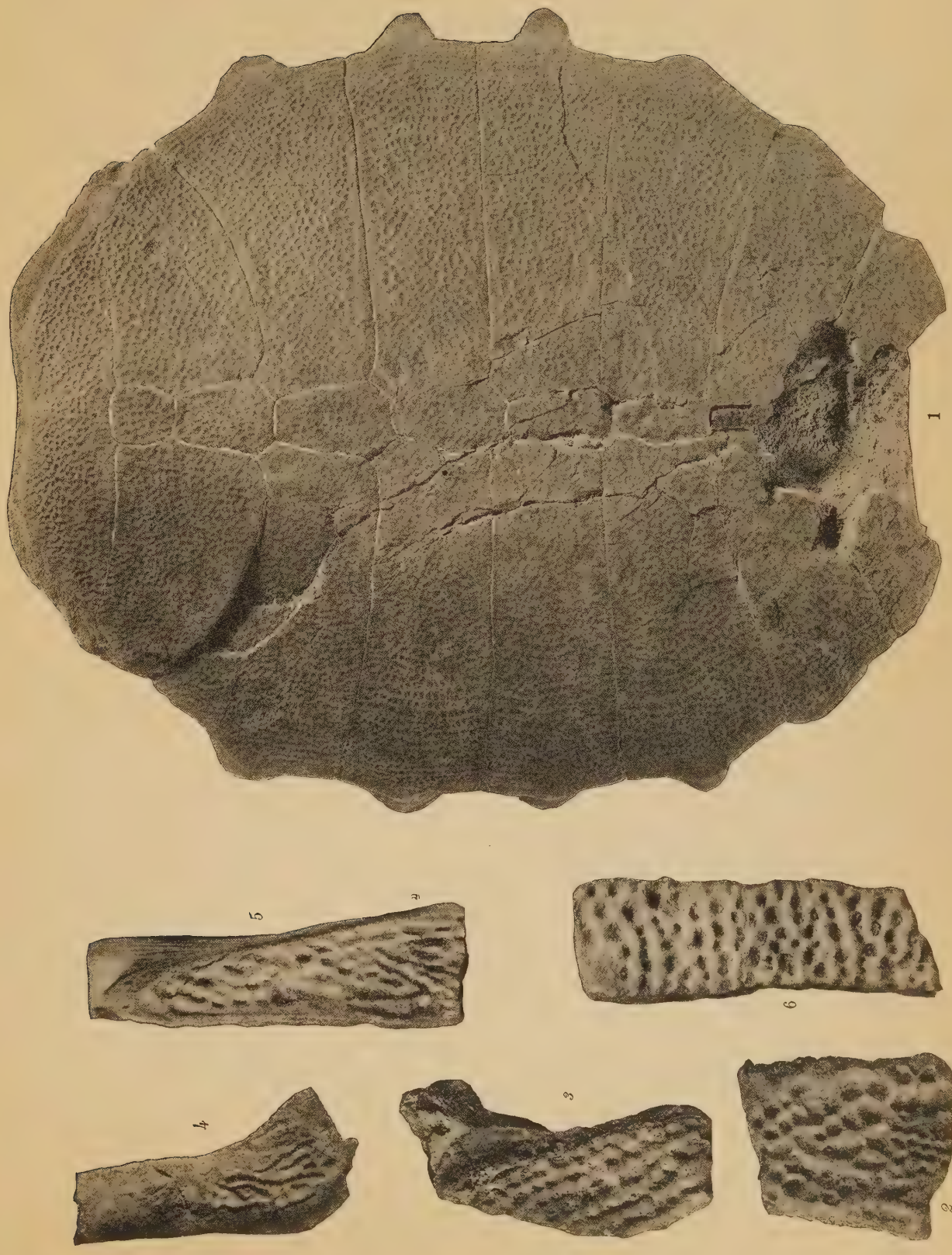
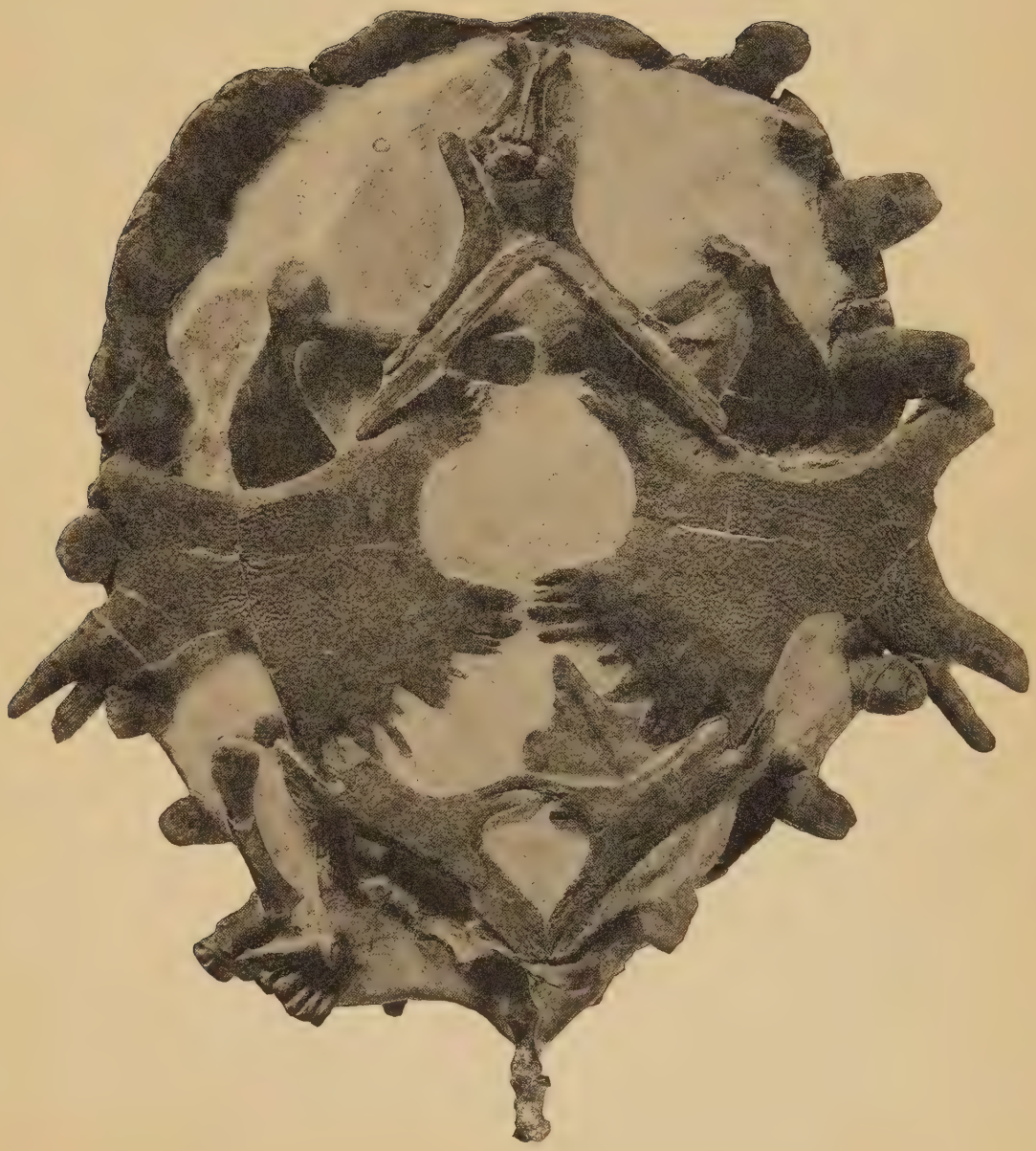


Fig. 1. Aspideretes grangeri. × ⅛. Page 507.
Figs. 2 to 6. Amyda? prisca. × 1. Page 512.

Fig. 1. Amyda salebrosa. × 0.3. Page 524.
Figs. 2 and 3. Aspideretes puercensis. × 0.6. Page 499.
Fig. 4. Axestemys byssina. × 0.43. Page 509.



Amyda franciscæ. × 0.4. Page 524.

Amyda franciscæ. × 0.4. Page 523.

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Fig. 1. Amyda scutumantiquum. × 0.3. Page 521.
Fig. 2. Platypeltis heteroglypta. × 0.38. Page 543.

3

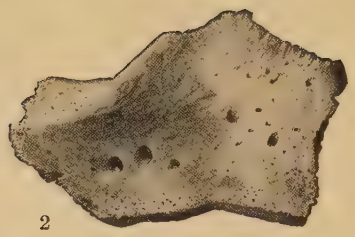

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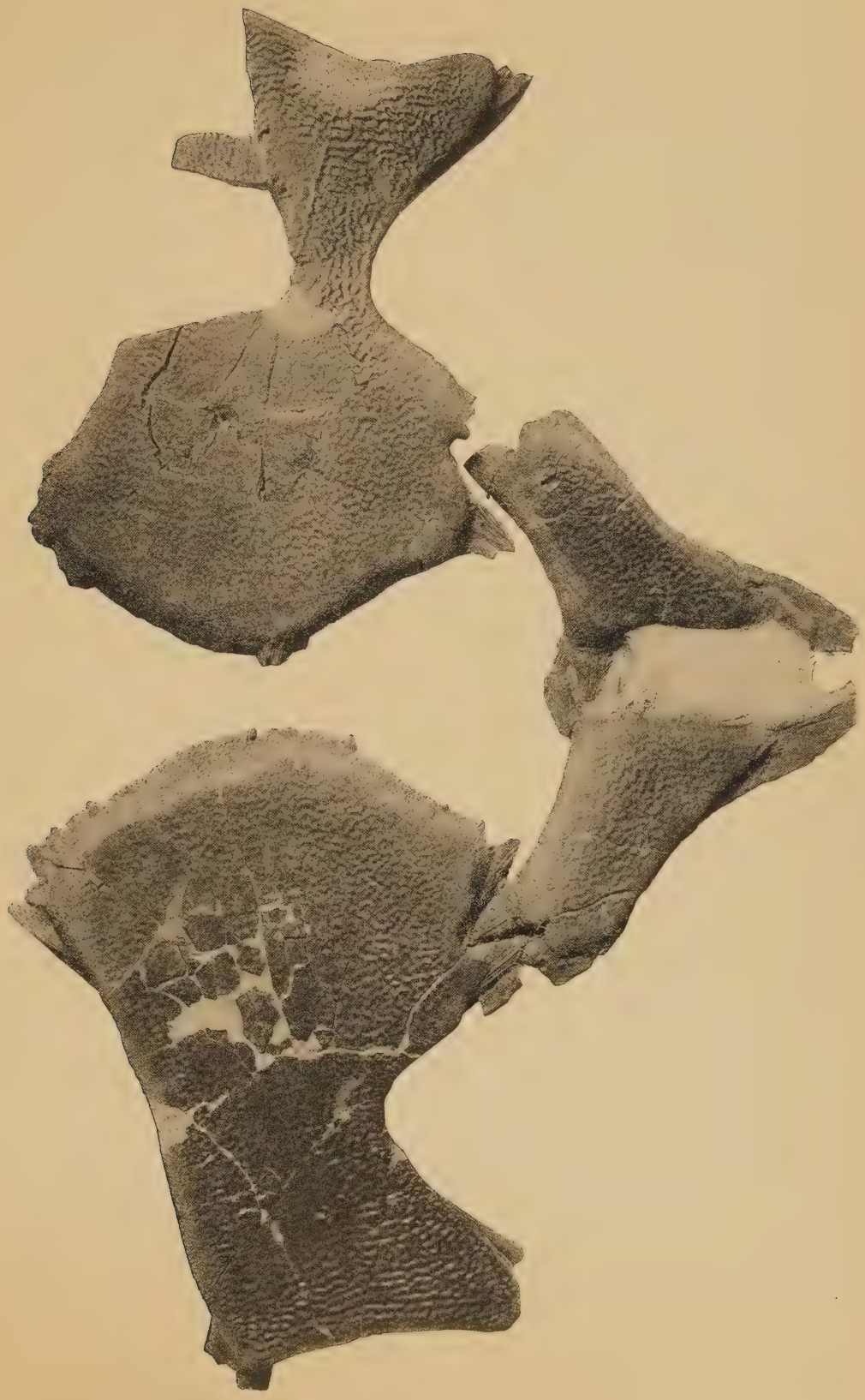
Fig. 1. Amyda mira. × ½. Page 527.
Figs. 2 and 3. Temnotrionyx manducans. × 1. Page 535.



Amyda mira. × 0.7. Page 528.

3

2

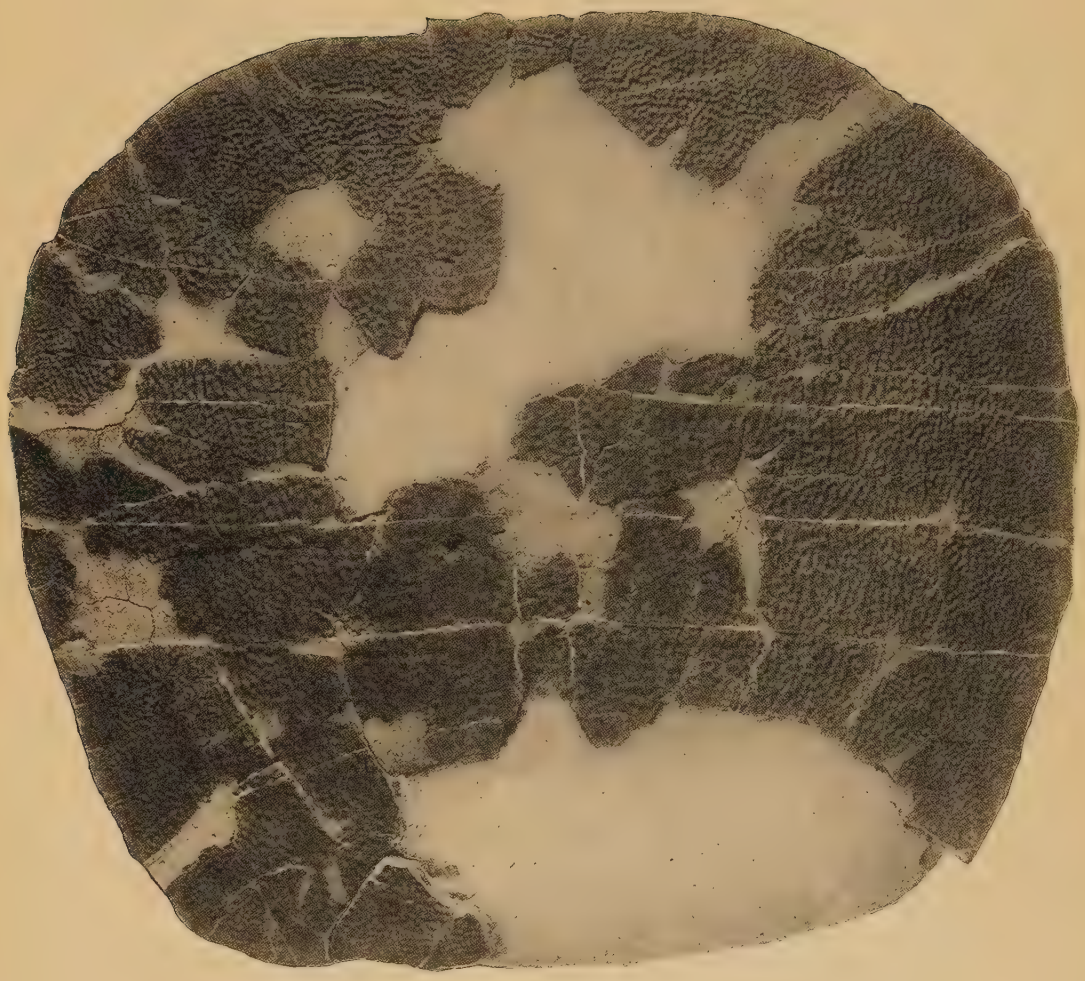
1

Amyda egregia. Fig. 1, × 0.4; Figs. 2 and 3, × 1. Page 531.

Amyda crassa. × 0.32. Page 532.

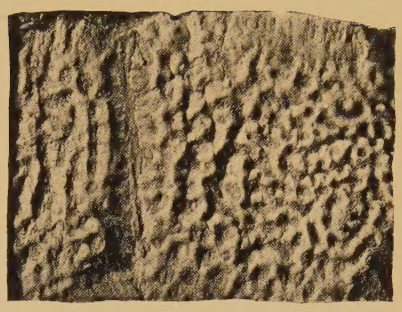
Platypeltis serialis. Figs. 1 to 3. × ¾; Fig. 4, × 1. Page 539.

Platypeltis postera. × 0.32. Page 545.



Platypeltis extensa. × 0.4. Page 546.

3



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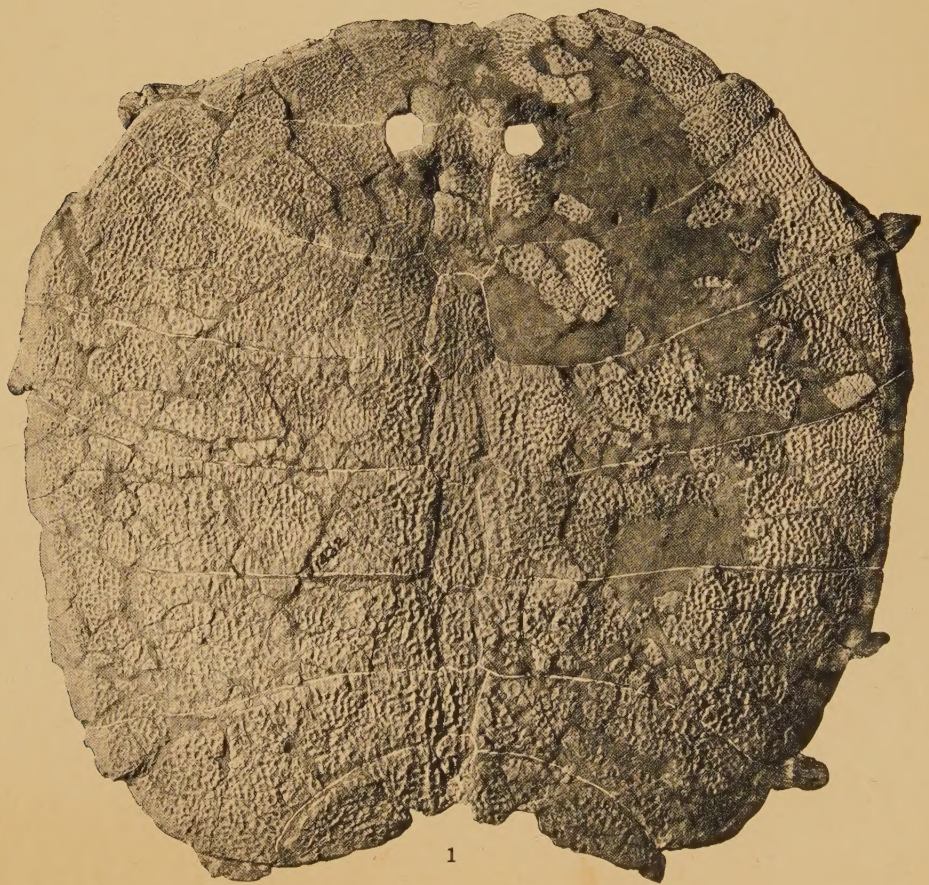

1

Platypeltis leucopotamica. Fig. 1, × ⅓; Figs. 2 and 3, × 1. Page 547.

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